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IMPROVEMENT TO THE STANDARDIZATION LIFE-CYCLE-COST MODEL FOR HU--ETC(U)
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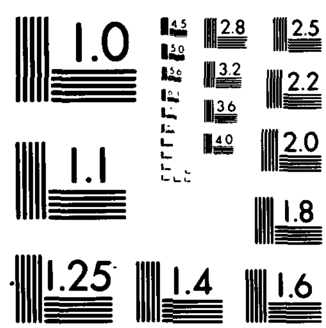

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FINAL REPORT
IMPROVEMENT TO THE STANDARDIZATION LIFE-CYCLE-COST MODEL FOR HULL, MECHANICAL, AND ELECTRICAL COMPONENTS AND EQUIPMENTS

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March 1980

Prepared for
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
SEA-90T
WASHINGTON, D.C. 20362
under Contract N00024-79-C-2683

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The objective of this project was to improve the existing Standardization Life-Cycle-Cost Model ~~(NAVSEC Report 6116D3-405-78, April, 1978)~~ and develop categories for the components within the Standard Components List (SCL). The model was improved by enhancing (revising) its sparing equations to make them more utilitarian by eliminating elements that did not provide significant life-cycle-cost differences between standard and similar non-standard components/equipments (C/E).

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10 by
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ABSTRACT

ARINC Research Corporation developed two new versions of the Standardization Life-Cycle-Cost Model -- the Enhanced Standardization Life-Cycle-Cost Model and the Simplified Standardization Model -- to assist acquisition managers in making comparative evaluations of standard and nonstandard hull, mechanical, and electrical (HM&E) components and equipments for shipboard installation. Data were collected for 20 HM&E components/equipments and entered into automatic data processing equipment, and estimates of life-cycle-cost differences were obtained by using both the enhanced model and the simplified model. The results were then analyzed to illustrate the models' capabilities as decision-making tools. In addition, a means of categorizing the Standard Components List by HM&E type and complexity was devised to provide information more readily to the user.

SUMMARY

The objective of this project was to improve the existing Standardization Life-Cycle-Cost Model (NAVSEC Report 6116D3-405-78, April 1978) and develop categories for the components within the Standard Components List (SCL). The model was improved by enhancing (revising) its sparing equations to make them more representative of Navy provisioning practices. The model was then made more utilitarian by eliminating elements that did not provide significant life-cycle-cost differences between standard and similar non-standard components/equipments (C/E).

A list of 20 components/equipments constituting a cross section of complexity was jointly selected by the Naval Sea Systems Command (NAVSEA) and the study team. Data were collected for these equipments, and both the Enhanced Model and the Simplified Model were used to provide estimates of life-cycle-cost differences. The Enhanced Standardization Life-Cycle-Cost Model (Enhanced SLCCM) provides a more accurate representation of the Navy spares provisioning than that provided by the original model's sparing equation. Analysis shows that the Simplified Standardization Model (SSM) provides nearly the same standardization life-cycle-cost predictive ability as the Enhanced Model and requires fewer data inputs. It is therefore predicted that the SSM will be easier to use in the field.

Approximately 1,000 representative Standard Components List (SCL) C/Es were categorized by complexity and type. The C/Es were Hull, Mechanical, and Electrical equipment (Deck and Hull Machinery, Fluid Systems, Refrigeration/Heating Systems, and Electrical Systems). The results of the categorization were used to develop a reformatted SCL Nomenclature Index.

The results of the study are summarized as follows:

- The SLCCM was improved by developing two new versions:
  - The Enhanced SLCCM -- recommended for use in the analysis of high-value HM&E C/Es and in all cases where the greatest possible accuracy is desired.
  - The Simplified Standardization Model (SSM) -- a reduced version of the Enhanced SLCCM that requires the use of fewer standardization life-cycle-cost estimates.
- The SCL Nomenclature Index was reformatted to provide ready information to the user regarding C/E complexity and type.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Naval ship acquisition policies require the consideration of all techniques that may contribute to reducing the total life-cycle cost of ships and shipboard equipment. One technique is the application of a life-cycle-cost model to evaluate the overall cost of "standard" versus "nonstandard" hull, mechanical, and electrical (HM&E) equipments. A standard equipment is one that is currently installed aboard at least one ship, is assigned an allowance parts list (APL), and is provisioned by the Navy supply system. Under Contract N00140-77-D-0417, a life-cycle-cost model was developed from the Naval Material Command's Life-Cycle-Cost Model for the Naval Sea Systems Command (NAVSEA) Standardization Branch (SEA-90T). The model was subsequently determined to be applicable to the DDG-47 Class ship acquisition program, and it was documented as the Standardization Life-Cycle-Cost Model (SLCCM) in Naval Ship Engineering Center (NAVSEC) Report 6116D3-405-78, dated April 1978.*

The application of this model in the ship design process has been considered by NAVSEA for use as an aid in selecting standard or nonstandard HM&E equipments in the DDG-48 ship class acquisition program. The model is somewhat imprecise, however, in that the method for computing the costs of provisioning and spares and repair parts does not follow Navy procedures and does not include the effects of existing inventory spares and the required spares population. Its use also requires the input of extensive component/equipment (C/E) data.

1.2 OBJECTIVE

The primary objective of this project was to improve the Standardization Life-Cycle-Cost Model (SLCCM) by making its sparing procedure more reflective of Navy practices and then to simplify the enhanced model to facilitate its use. Two separate models resulted from the effort. The Enhanced SLCCM provides a more appropriate spares provisioning capability than the original

*The SLCCM models only those costs related to standardization; several life-cycle-cost contributors, such as research and development expenditures, are not employed.

SLCCM and is intended as a direct replacement for that model. The Simplified Standardization Model (SSM) is less time-consuming, is easier to use, and is intended as a substitute for the Enhanced SLCCM when the more comprehensive output of that model is not required. Both of the models are intended to assist Navy acquisition managers in determining whether or not to approve the use of contractor-recommended nonstandard equipment. A further objective was to reformat the Standard Components List (SCL) so that it could be used more quickly and could make information more easily accessible.

1.3 REPORT STRUCTURE

The following chapters provide descriptions of the technical approach and analysis techniques applied to develop, verify, and utilize the Enhanced SLCCM and an abbreviated or simplified version of it. Standardization life-cycle-cost information is provided for 20 selected C/Es of varying complexity. Conclusions and recommendations drawn from this effort are then presented.

Seven appendixes present detailed information complementing the topics in the main body of the report. Appendix A provides the basic Navy method for calculating On-Board Repair Parts and System Stock Parts, from which the derivative program routines in the Enhanced SLCCM were developed.

The entire Enhanced SLCCM is presented in Appendix B, which will be of interest to anyone wishing to program the Enhanced Model or use it to conduct a standardization analysis. Appendix C presents standardization costs, by individual element, for the C/Es used for model verification. Appendix D contains a sample set of computer program runs for both the Enhanced SLCCM and the SSM. Appendix E presents standardization costs, by individual element, for each of the study C/Es analyzed through use of the Enhanced SLCCM and SSM. Appendix F is the SCL Nomenclature Index, in a recommended new format. Appendix G is a list of the acronyms employed in the report.

CHAPTER TWO

APPROACH

This chapter describes the approach used to develop the Enhanced SLCCM and the Simplified Standardization Model (SSM), as well as the tests and demonstration of the models. It also describes the method used in developing the proposed new format of the SCL.

Figure 2-1 depicts the interrelationships and flow of the study tasks. The reformatting, or categorization, of the SCL, while related to

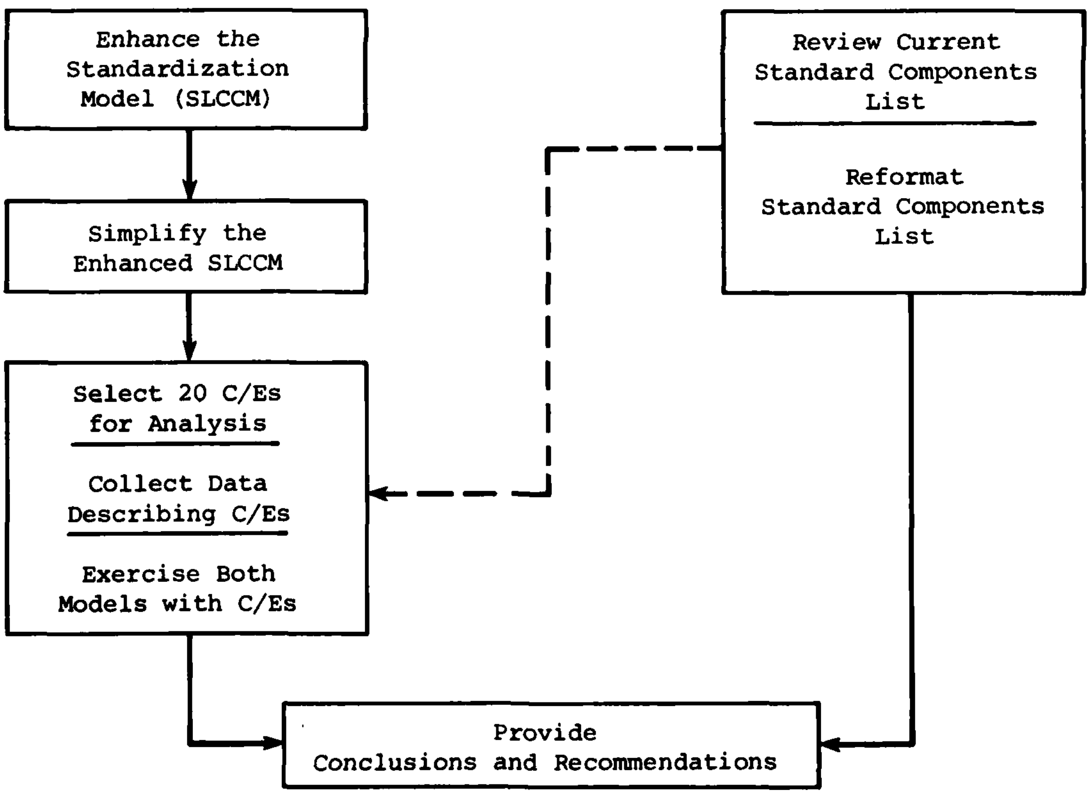

Figure 2-1. STUDY FLOW DIAGRAM

the standardization efforts, was treated as a separate task during the study and is so depicted in the figure.

2.1 ENHANCEMENT OF STANDARDIZATION LIFE-CYCLE-COST MODEL

The current SLCCM does not include the effect of existing system stock available from prior provisioning of each standard C/E. Further, it does not take into account the existing on-board repair parts that support the installed C/E fleet population. Enhancement of the SLCCM was achieved by replacing the spares equation with a more detailed routine that includes:

- On-board spares/repair parts in the fleet and wholesale spares
- Sparing procedures employed by the Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania

2.1.1 Navy Sparing Procedures

Before modifying the SLCCM, it was necessary to review the procedures currently employed by the Navy to support Fleet HM&E C/Es. This was accomplished through discussions with Naval Supply Systems Command (NAVSUP), Naval Materiel Command (NAVMAT), Naval Weapons Engineering Support Activity (NAVWESA), and Naval Ship Systems Engineering Station Detachment - Mechanicsburg, Pennsylvania, (NAVSSES) personnel, as well as personnel assigned to SPCC. Further, the Fleet Logistics Support Improvement Program (FLSIP) was examined to determine what input parameters required for repair part determinations affecting spares cost could be appropriately included in the Enhanced SLCCM. Finally, it became apparent that an understanding of the overall procedures for spares requirements determination flow would be of direct benefit to the study effort. The understanding would be gained through review of available documentation and further discussion within the Navy organizations noted above; and it would ensure that the study team had taken into account all significant influences in Navy spares determination and costing.

While the procedures review was in progress, there was a similar review of the altered sparing procedures followed when a C/E not already in the Navy inventory is chosen for acquisition. In this report, the latter type of C/E is designated as "nonstandard," while the C/E already in the Navy inventory is designated as "standard."

2.1.2 Enhancement

In the original SLCCM, costs for spare parts are determined solely on the basis of a straightforward calculation of spare part pipeline requirements. In that calculation, all spare parts are assumed to be ordered when needed; no production delay time is considered for part replenishment, and no repair delay is included for repairables. Pipeline quantities are calculated as functions of replenishment delays and part usage at the organizational/intermediate (O/I) and depot levels. In addition, no allowance is made in this sparing calculation for reducing new spares requirements because

spares are already available in the Navy support system. To provide for more realistic evaluation of spares costs, a sparing routine that reflects sparing methodologies used by SPCC was developed -- largely by modeling Navy sparing activities as defined in SPCCINTINST 4400.30C. The substitution of this new routine for the pipeline calculation resulted in the Enhanced SLCCM.

2.1.3 Verification of Enhanced Model

The Enhanced Model was verified through two separate comparisons involving the number of spares in one instance and the overall standardization life-cycle cost in the other.

In the first comparison, actual APL spare parts data were obtained for one of the standard C/Es used to validate the original SLCCM. The number of parts in the APL was directly compared with number of parts calculated by using the Enhanced Model. In theory, if the model calculates the same number of spares as the SPCC, the APL and model spares requirements for the trial C/E should be reasonably similar.

In the second comparison, the data for the same C/E were employed to exercise the Enhanced Model. Resultant cost outputs were compared with the output from the original SLCCM.

2.2 SIMPLIFICATION OF THE ENHANCED SLCCM

The utility of the Enhanced Model is encumbered by the large volume of data inputs required for its operation (the number depends largely upon the number of parts within a given C/E but is always in excess of 100 entries). To counter this, the model was examined to evaluate possibilities for simplifying it into a Simplified Standardization Model (SSM). The intent was to develop a model that (1) supports the standard versus nonstandard decision-making process in the same manner as the Enhanced Model, (2) determines a standardization life-cycle cost that approximates the cost generated by the SLCCM, and (3) requires a significantly smaller volume of input data than the Enhanced Model.

2.2.1 Influence of Input Parameters

A sensitivity analysis was performed to measure the influence of the data inputs on the standardization life-cycle cost for each C/E examined. A variance program routine was used on the Enhanced SLCCM inputs, with all data inputs individually varied plus and minus 25 percent. The resulting SLCC outputs were evaluated if they differed from the original SLCC by one percent or more.

2.2.2 Revision of Enhanced Model

The results of sensitivity analyses were examined to determine major cost-contributing elements. The cost elements in the Enhanced Model were ranked by contribution, and the major contributors were identified. At the

same time, the sensitivity analysis was used to ensure that potential cost-driver data inputs were not unknowingly eliminated. The Enhanced Model was then revised by selecting major cost elements and eliminating those which had insignificant impact. The equations were then revised to reflect the changes.

2.2.3 Verification of Simplified Standardization Model

The objective of the SSM verification was to assure that this abbreviated model would derive standardization life-cycle costs that provided indicators reasonably similar to those obtained through use of the Enhanced SLCCM. Because the SSM will compute and sum a reduced number of standardization model element costs, it was expected that the SSM costs would usually be lower than those provided by the Enhanced SLCCM.

Twenty C/Es were analyzed through application of both the Enhanced SLCCM and the SSM. Results were compared to verify the SSM and to establish criteria for its use.

2.3 C/E SELECTION, DATA COLLECTION, AND MODEL EXERCISE

Through examination of the SCL, C/Es were selected for use in development, test, and exercise of the Enhanced SLCCM and SSM; the selection was made in a way that would ensure an equal distribution of C/Es in terms of complexity. It was necessary to select 20 C/Es, collect data input for the C/Es, and use the data in both models. Three additional C/Es employed during validation of the original SLCCM were also used.

2.3.1 Selection of Components/Equipments

A C/E for which an SLCC had been derived* was used to ensure that enhancement results were reasonable and that other portions of the model were unaffected by the new routines. Two other C/Es (from the same source) were used to compare Enhanced SLCCM results and the derivative SSM results.

Subsequent to the development testing, 20 C/Es were selected from the SCL for analysis with both the Enhanced SLCCM and the SSM. SCL-listed C/Es are standard C/Es; i.e., they each have an APL and have at least one installation in the fleet. The C/Es were selected from each of the five complexity categories. The complexity categories from which the C/Es were selected were determined by the number of line items in each C/E's APL. The categories range from the least complex -- not more than one APL line item, to the most complex -- more than 50 APL line items. As a result of a subsequent review, a number of the original selections were replaced with others that were high-volume fleet C/Es and were still being produced by vendors.

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*These SLCCs were developed for a related effort; they are described in *Interim Report, Standardization Life-Cycle-Cost Analyses*, June 1979, ARINC Research Publication 1863-01-SR-1962.

2.3.2 Required Data and Source Identification

The SLCCM requires at least 104 inputs for each C/E. The Enhanced SLCCM requires additional inputs depending on the numbers of replacement parts within each C/E. The SSM requires fewer inputs, many of which are preassigned and are used for all C/Es. Inputs for all three models are obtained from the same set of data. The required data are categorized as follows:

- Prime C/E data - specific technical data directly related to the designated C/E.
- Standard data - general input and cost data normally obtained from the Government or contractors. This type of data is used for all C/Es.

This last group comprises "universal" data, which are constant for most equipments regardless of which model is in use, e.g., annual National Stock Number (NSN) maintenance costs.

Engineering estimates or extrapolations are used when actual data are not available. These are derived from interpretation of related work efforts, or from composites of several data inputs (for example, data for depot maintenance storage space are obtained from information on size, numbers in inventory, and numbers of spare parts). Other data inputs are derived from reference materials and interviews with Navy personnel. With minor modifications and, where appropriate, inclusion of the additional spares entries, the input data remain the same as those required for the SLCCM presented in NAVSEC Report 6113D3-405-78, April 1978.

2.3.3 Data Collection

The first step in the data collection process was to identify the information needed for the analyses. The second step of the collection process consisted of identifying sources for this information. The remaining step was to query those sources to gain the required information. Documentation was ordered or otherwise located for review and direct interviews, and telephone discussions were arranged with cognizant personnel. As appropriate, approximations were made by extrapolation, comparisons with similar C/Es, and engineering estimates.

2.3.4 Exercise of the Models

Both the Enhanced SLCCM and the SSM were developed with the SLCCM used as the baseline model. To test the model development, it was convenient to employ data that had been gathered for C/Es previously used in the SLCCM. Additional data inputs for each C/E were used in the Enhanced SLCCM, including the sparing routines. As a verification procedure, the outputs of the new models were compared with the results from the baseline SLCCM. This required computer program exercises for one to three C/Es with each model. Two C/Es used for validation of the Enhanced SLCCM were also exercised with the SSM.

Obtaining a differential (or delta) between the SLCC of a standard C/E and the SLCC of a nonstandard C/E that has been recommended as a substitute is useful when acquisition of a ship's C/E is being considered. To obtain this delta, it is necessary to provide input data on both standard and nonstandard C/Es for use with the standardization models.

Two computer program runs were made with each model for each of the 20 C/Es employed in the study. The first program run for each C/E was made with data as collected, a "standard run." For the second program run with each C/E, the standard input data were altered to create a nonstandard C/E. (Such pseudo-nonstandard C/Es are employed in this study because appropriate nonstandard replacements for the 20 selected C/Es were not identified and, in fact, may not exist.) The alteration was based on whether a standard C/E input was different from that which would be entered if a C/E were nonstandard; for example, the cost to prepare an APL for a standard C/E would be zero (the APL already exists), but a cost would be entered for a nonstandard C/E. In other cases, the cost was merely lower for the standard C/E data input. In a few cases, the SLCC for a standard C/E may exceed that for a nonstandard: for example, the prime equipment procurement price could very well be lower for a nonstandard C/E.

The number of times each model was exercised for testing, standard C/Es, and nonstandard C/Es is shown in Table 2-1.

Table 2-1. MODEL PROGRAM RUNS*

Model	Testing	Standard C/Es	Nonstandard C/Es
Enhanced SLCCM	4	20	20
SSM	6	20	20

*Includes only complete exercise of the models. Multiple program runs to develop or test subroutines and to obtain standard/nonstandard differences are not incorporated in these totals. Partial runs to provide specific data readouts are also excluded.

2.4 CATEGORIZATION OF STANDARD COMPONENTS LIST*

The Standard Components List (SCL) is a valuable tool for Naval ships acquisition personnel and the shipbuilder alike. With the Master Integrated Allowance Parts List, it provides reference data for Government personnel

*"Naval Sea Systems Command Components List for Hull Mechanical Electrical Equipment" (NAVSEA S-0300-AA-PLL-00-0, 1 October 1978).

and permits the shipbuilder to identify recommended standard C/Es that are in accord with design specifications and standardization requirements.

The current SCL format lends itself to rapid reference for those who use it directly on a day-to-day basis. The occasional user, however, finds it difficult to use. The objective of this effort is to make the SCL easier to use by providing more readily accessible information. To achieve this objective, the SCL was reviewed and reformatted in the following manner:

- The categories developed during a previous study* were used. C/Es were classified by similarity, representing divisions of a Ship Work Breakdown Structure (SWBS)
- A set of sample C/Es was selected from the SCL to be representative of similar equipments within each group. A three-step selection method was employed:
  (1) Random samples from each selected SCL set (e.g., all listed *Motor Electric, AC, 2-speed* C/Es are a SCL set) were reviewed. The C/E with the greatest number of fleet installations was selected. If the SCL set was large, more than one random sample was selected.
  (2) Each selection was examined to determine the number of line items appearing on the C/Es APL.
  (3) The selected C/E with the largest number of APL line items in each set was chosen to represent the set.
- The selected sample C/E was then "classed" by SWBS.
- Each selected sample C/E was assigned into a complexity category. The assignment was based on the number of APL line items making up the C/E and the bounds of each complexity category. The complexity categories were described in ARINC Research Publication 1821-11-1-1733.* The complexity categories are shown in Table 2-2.

Table 2-2. COMPLEXITY CATEGORIES FOR C/Es

Complexity Category	APL Line Item Range
A	0-1
B	2-6
C	7-13
D	14-50
E	More than 50

- Finally, a reformatted SCL Nomenclature Index was prepared by using the sample sets of representative C/Es (there are approximately 1,000 C/Es in the sample).

**The Cost-Effectiveness of Standardization for Hull, Mechanical, and Electrical Equipment,* April 1978.

CHAPTER THREE

ANALYSIS AND RESULTS

This chapter describes the development of the Enhanced SLCCM and the SSM, the verification and use of the models for selected Navy C/Es, and a proposed reformatting of the SCL.

3.1 ENHANCEMENT OF STANDARDIZATION LIFE-CYCLE-COST MODEL

The Enhanced SLCCM was developed by improving the method used to compute spares cost. That development and verification of the model are discussed in this section.

3.1.1 Navy Sparing Procedures

The sparing procedures used by the Navy were reviewed to derive an accurate method of calculating the cost of standard and nonstandard HM&E spare/repair parts for inclusion in the SLCCM. From this review, diagrams were developed to show the methods used by SPCC to determine the additional parts costs when standard or nonstandard C/Es are introduced into the Navy inventory. Information used to develop the diagrams, shown in Figures 3-1 and 3-2, was obtained from Navy documentation (principally SPCCINTINST 4400.30C), interviews with cognizant Naval personnel, and other Navy-funded studies.

Both diagrams show the general methodology in use at SPCC for spare parts provisioning. The dashed-line box in Figure 3-2 shows an alternate means of estimating parts cost for a nonstandard C/E when shipbuilder/vendor data are not available (from Form 4786/4786A). This method requires identification of a C/E similar to the recommended nonstandard C/E, usually through reference to the SCL. The similar C/Es APL is obtained, and from that document its sparing is determined by National Stock Numbered parts. These parts are then costed through use of the Navy Management Data List (NMDL).

The original SLCCM determines spares requirements simply on the basis of a calculation of the number of items needed to fill the ordering and delivery pipeline for each C/E part. Spares requirements are modeled by using part quantity, lead time, and failure rate to determine the number of spares needed to fill the pipeline. This model is linear. It calculates allowances of non-whole parts and does not provide for spares-sharing benefits.

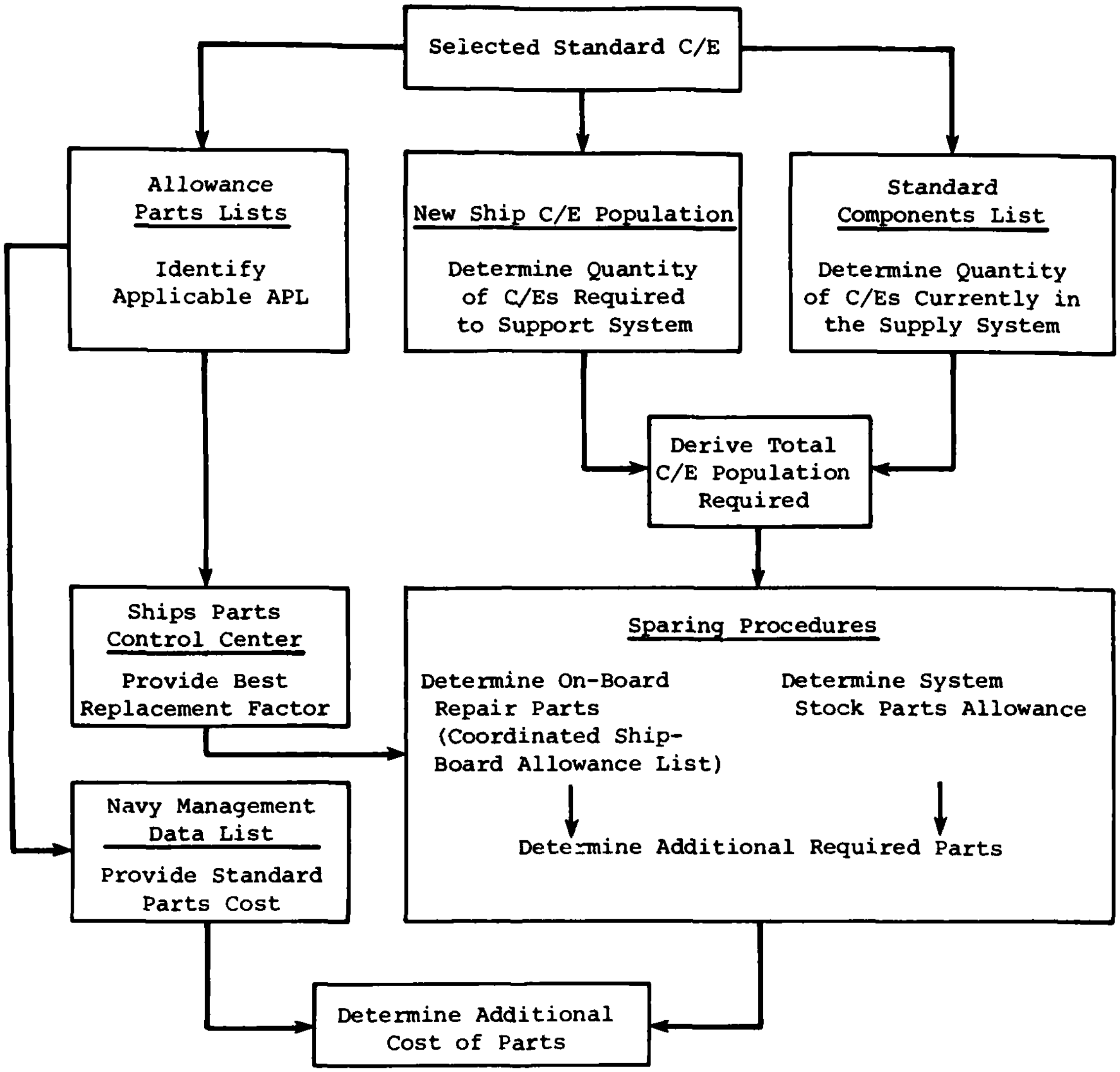

Figure 3-1. PARTS COST DETERMINATION: STANDARD C/E

To improve the original SLCCM, the linear SLCCM sparing pipeline routine was replaced with a routine of the SPCC spares provisioning methodology.

3.1.2 Enhancement

Enhancement of the SLCCM consisted of removing its linear sparing pipeline routine and replacing it with a routine of the sparing methodology used by SPCC. The routine developed to represent the SPCC sparing methodology has two sections, one to determine on-board spares requirements

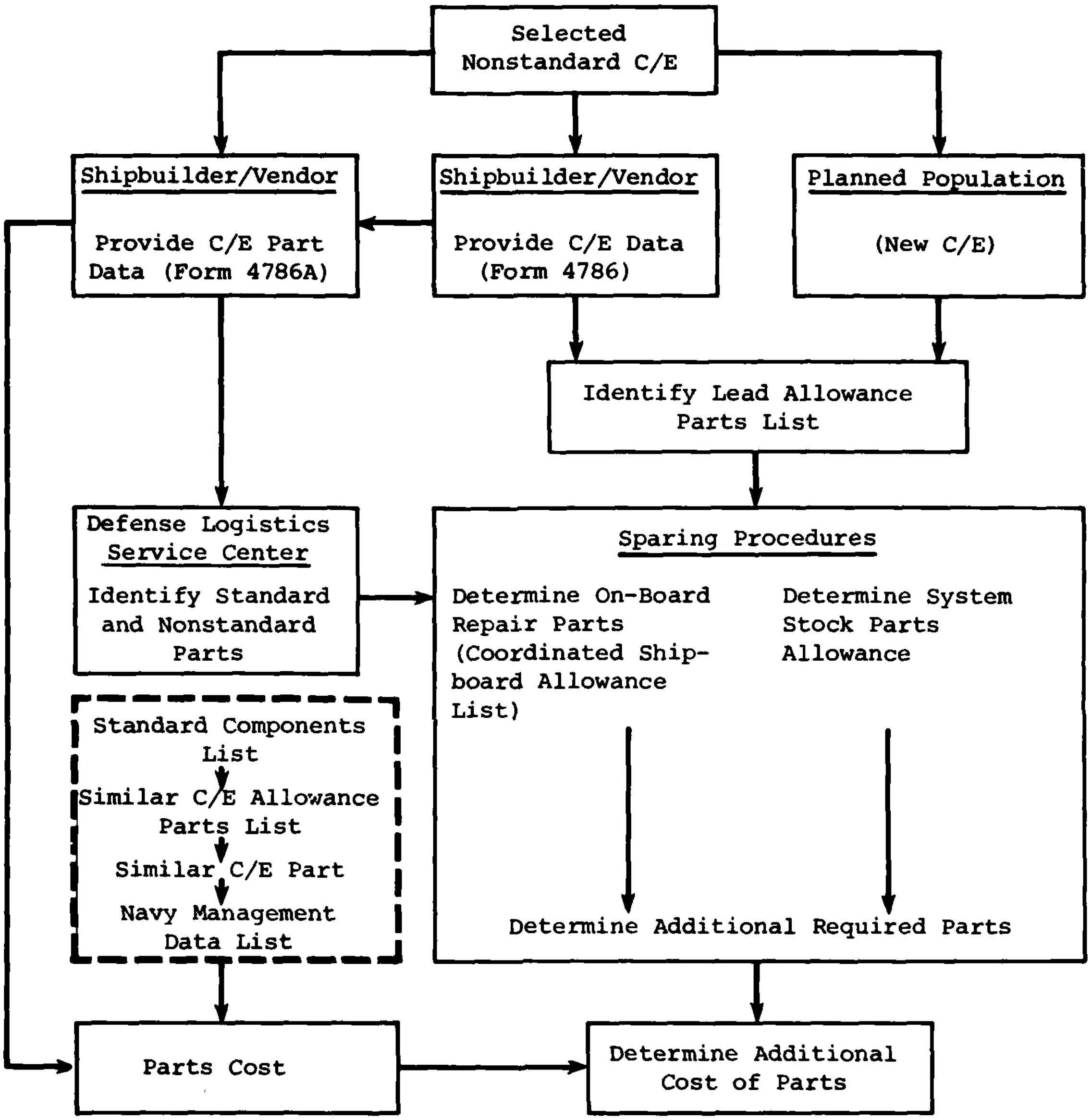

Figure 3-2. PARTS COST DETERMINATION: NONSTANDARD C/E

(Figure 3-3) and one to determine overall system stock parts allowances, also known as wholesale stock (Figure 3-4). Appendix A summarizes the SPCC procedures for determining these on-board and wholesale spares requirements. Data for the parameters shown as Inputs in Figures 3-3 and 3-4 are needed to establish spares requirements for each part. Table 3-1 lists and defines these input parameters.

The procedure illustrated in Figure 3-3 is used to determine the number of on-board spares required for each part. First, the expected quarterly

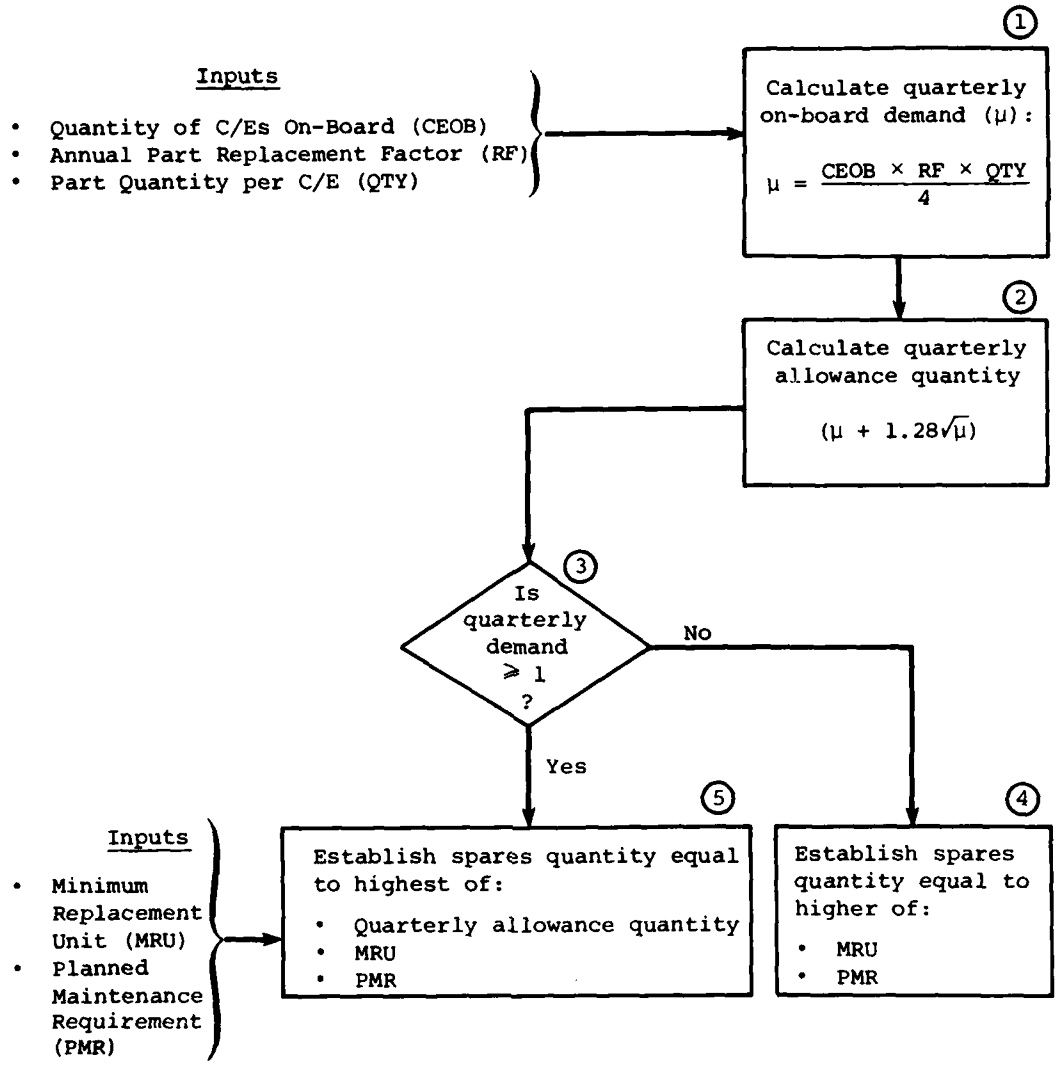

Figure 3-3. FLOW SCHEMATIC: MODEL OF SPCC METHODOLOGY FOR ON-BOARD SPARES DETERMINATION

demand (μ) for the part being spared is calculated (Block 1). A quarterly on-board spares allowance quantity is calculated from the expected demand quantity (Block 2). If the quarterly parts demand is less than 1.0, the part on-board spares quantity is selected as the higher value of MRU and PMR (Block 4). If the quarterly parts demand is equal to or greater than 1.0, the part on-board spares quantity is selected as the highest of the calculated quarterly allowance quantity, MRU, or PMR (Block 5). In this procedure MRU and PMR are always integers. The quarterly allowance quantity is also used as an integer. The calculated amount is rounded upward to the next higher integer value when its calculated fractional part is greater than or equal to 0.5. Otherwise, it is truncated to the next lower integer value.

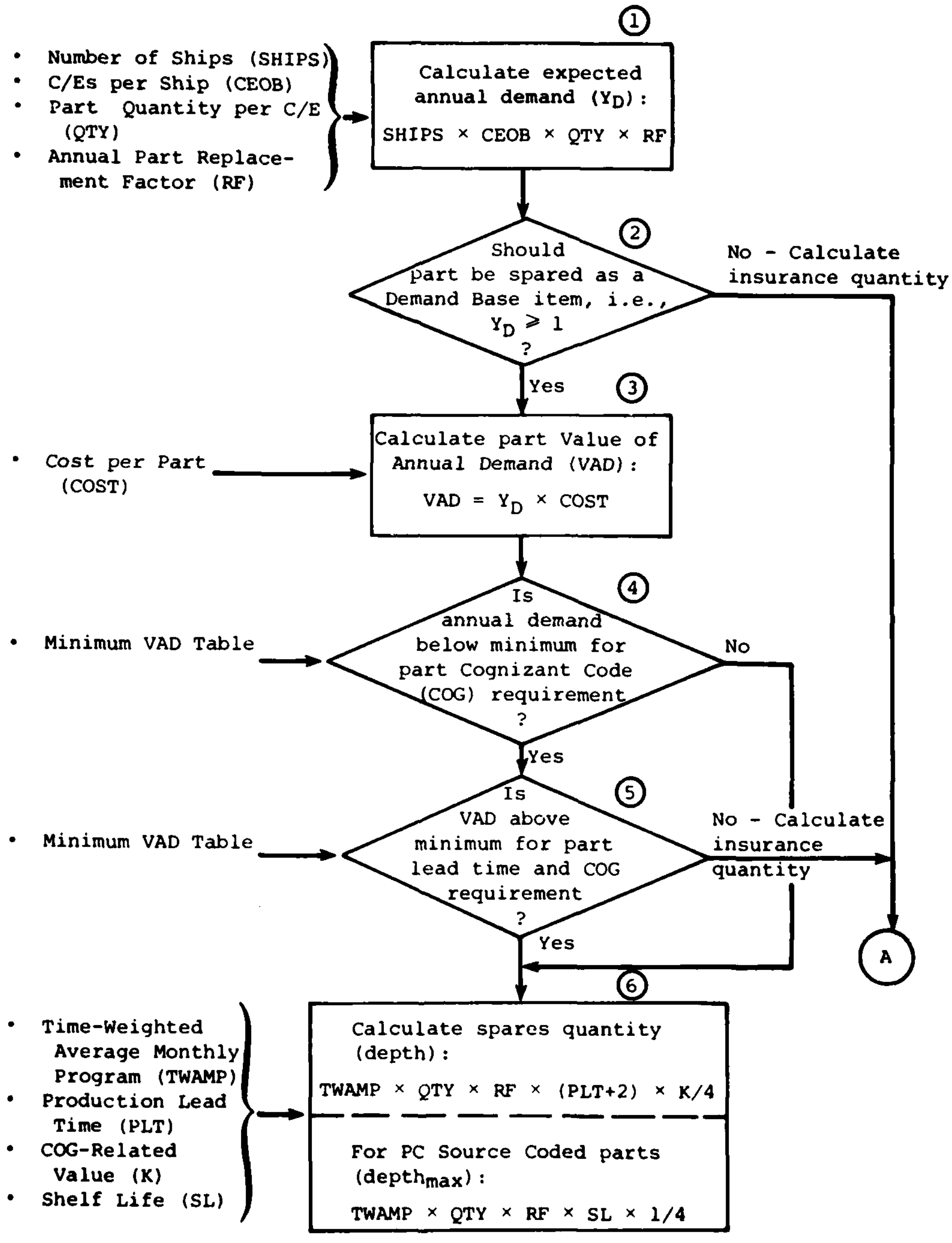

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Figure 3-4. **FLOW SCHEMATIC: MODEL OF SPCC METHODOLOGY FOR WHOLESALE SPARES DETERMINATION**

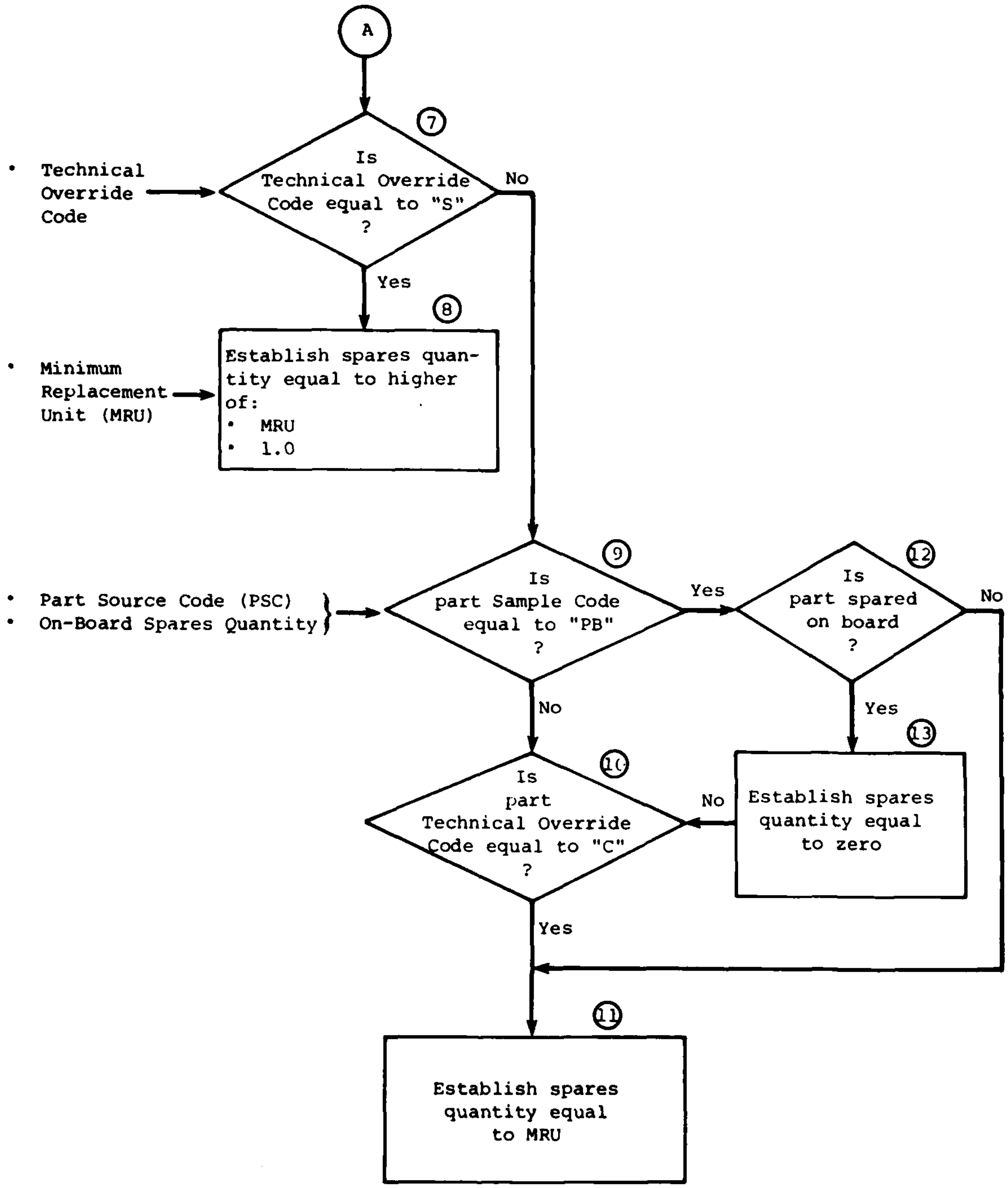

Figure 3-4. (continued)

Table 3-1. SPARE REQUIREMENTS DATA INPUTS	
Symbol	Identification
COG	Cognizance Code - Identifies stores account and cognizance symbol.
MRU	Minimum Replacement Unit - Quantity of part to be replaced when repair is required.
PLT	Production Lead Time - Estimate of total calendar time needed to produce a spare part.
PMR	Planned Maintenance Requirement - Used to determine override amount. Quantity of a repair part required for replacement at a given time or after a number of operating hours.
PSC	Source Code - Indicates manner of acquiring support parts for maintenance, repair, or overhaul of C/E.
QTY	Quantity - Part quantity per C/E.
RF	Replacement Factor - Provisioning estimate of anticipated demand of the part in the particular application.
SL	Shelf Life - Estimate of shelf life of part from manufacture date to disposition or test for continued usefulness.
TOR	Technical Override Factor - Provisioning decision that may override allowance range.
VAD	Value of Annual Demand - The product of Y (Years in life-cycle analysis) times the unit price.
YD	Annual Demand - The expected annual replacement quantity.
CEOB	New C/Es - The number of new C/Es per ship resulting from standardization evaluation.
POPZ	Fleet C/Es - The number of C/Es in the fleet prior to new procurement.
POPOB	Ship C/Es - The number of C/Es per ship prior to new procurement.
SHIPS	Total Ships - The total number of ships upon which the new C/E will be installed.
Note: All except the last four inputs are variable parts data input.	

The number of wholesale spares is determined by means of the procedure diagrammed in Figure 3-4. First, the total fleetwide expected annual demand is calculated (Block 1). If this annual demand is less than one, then the part can only be spared as an insurance item. If annual demand is greater than or equal to one, it can be considered for sparing as a demand-based item. There are two tests to determine whether or not sparing should be demand-based. In the first test (Block 4) the annual demand quantity is compared with the minimum quantity requirement established for the part's

cognizance code. If the annual demand is below the minimum quantity, it is tested against the minimum established for the part's cognizance code and resupply lead time (Block 5). If the annual demand is above the minimum quantity, the wholesale spares quantity is calculated as shown in Block 6. If the annual demand is lower in both cases, the part is considered for sparing as an insurance item.

For parts to which "S" has been assigned as the Technical Override (TOR) code (requires OBRP in multiples of MRU), insurance wholesale spares are established equal in a quantity of one or the MRU quantity, whichever is greater (Block 8). Parts with TORs other than "S" and a "PB" source code (essential part) are system-stock-spared only as insurance items (in a quantity equal to one MRU) when there are no on-board spares established for the part (Blocks 9, 12, 13, 11). Otherwise, no wholesale spares are allowed. Parts with source codes other than "PB" are spared as wholesale insurance spares only when their assigned TOR code is "C" (permits OBRP when requirement is equal to or greater than 0.0625 of a part). In this case, an insurance spares quantity equal to the part MRU quantity is allowed.

In the Enhanced SLCCM these procedures are used twice: once to determine the spares quantity existing before acquisition of the new C/Es, and once to determine spares quantity required following acquisition of the C/Es. Thus if 10 of a C/E type are already in the fleet and 12 more are being acquired, the procedures are exercised once with 10 C/Es and once with 22 C/Es (10 + 12). In each case the total of spares for each part equals on-board spares plus wholesale spares. The difference between the "existing C/Es" case and the "existing plus new C/Es" case in total spares quantities determined for each part is charged as spares to the new C/E acquisition being considered. The cost of these spares is calculated in SLCCM base-year dollars. The base-year spares cost is then divided among the C/E life-cycle years in proportion to the quantity of C/Es acquired in each year. The resulting spares cost charged to each life-cycle year is inflated appropriately. Appendix B contains a description of the Enhanced SLCCM.

3.1.3 Enhanced Model Verification

The spares required by an existing C/E's APL were compared with those obtained from the Enhanced SLCCM. Although the comparison was reasonable for the C/E used, analysis of the sparing process shows that results of such comparisons should be carefully evaluated.

The Enhanced SLCCM was also verified by comparing the required number of spares for a C/E with the number determined by the original SLCCM.

3.1.3.1 Comparison with Allowance Parts List Data

At the outset of the study, it was believed that a comparison of the model's sparing routine output for a standard C/E with the spares allowed by the existing APL would be a reliable means of verifying that the routine was functioning adequately. Upon analysis, it became apparent that this may not always be practical. Differences in spares allowances computed by the

standardization model and the allowances shown in the APLs can sometimes be significant. These differences can be caused by the following factors:

- An APL's allowances are based partly on its "parent" lead APL (LAPL). The LAPL is often years old and may contain information that is out of date; for example, original LAPLs use Technical Replacement Factors (TRF) that are essentially estimates of spare parts demand based on experience. Subsequent to fleet introduction, actual fleet maintenance of the C/E will provide more accurate Best Replacement Factors (BRF), which may be quite different from the earlier TRF. The standardization models use BRFs when they are available (in most instances in study samples). Since the Best Replacement Factor is of major significance in computing spares, the spares requirements obtained by using the model may be different from those in the existing APL.
- If the 90-day spares requirement is less than one of a particular part, that part may still be allowed as an insurance spare (a spare of one). A variety of factors may be analyzed to make a decision for such authorization, the major ones being that the individual 90-day spare part requirement (calculated through use of the FLSIP Allowance Table, Appendix Table A-1) is for a quantity of at least 0.0625 (i.e., less than one part) and that the part be vital to the C/E's operation. The standardization model recognizes the 0.0625 minimum requirement but treats all spares at that or higher requirements levels as vital to the C/E's operation.

The effect of the TRF/BRF differences could cause a wide variation in the spares allowance. Considering certain spares as vital to the C/E can, in some cases, permit a computation allowance of one spare where the APL would allow none. Small differences between the model computation and the APL can occur as a result of parts packaging; for example, it may be impossible to spare less than one package of three bolts where only two bolts are required. Thus, although the original APL sparing figures were formally calculated in a standard manner, other calculations may use different factors and result in different sparing quantities.

Nevertheless, the C/E* used in the verification of the Enhanced SLCCM shows close agreement between APL and Model requirements:

- Of 26 spare parts, 20 were spared the same by both the APL and the model.
- Of the remaining six parts, five were within one of being identically spared.
- Sparing of one part differed by an allowance of two.

*Filter (lube oil), APL 487140001, LAPL 48-002.

3.1.3.2 Comparison with Results of Standardization Life-Cycle-Cost Model

The plan to compare the results of an Enhanced SLCCM analysis with the results of a SLCCM analysis was completed for the same C/E used in the foregoing APL comparison.

The differences between the SLCCM and Enhanced SLCCM results occurs in the area of support acquisition. This was expected since the SLCCM and the Enhanced SLCCM are identical except for the Enhanced Model's improved ability to predict required spare parts. In extension of the comparison to both the standard C/E and a nonstandard C/E, it became apparent that there is an SLCC increase when it is computed by the Enhanced Model (see Table 3-2).

Table 3-2. SLCCM VERSUS ENHANCED SLCCM -- SLCC DIFFERENCES (THOUSANDS OF DOLLARS)

Standard C/E		Nonstandard C/E		Model Differences	
SLCCM	Enhanced SLCCM	SLCCM	Enhanced SLCCM	Standard C/E	Nonstandard C/E
1,741	1,756	1,892	1,908	15	16

The results suggest that either the SLCCM or the Enhanced SLCCM can be used for SLCC comparisons between standard and nonstandard C/Es. There are, however, two situations in which use of the Enhanced version is indicated. First, where failure rates of high-value C/E parts are expected to be high, the Enhanced SLCCM will provide a more accurate picture of the support costs than the SLCCM. Second, if in addition to the total SLCC the user has a need to discriminate between standard and nonstandard costs shown by an individual spare-related support element, the Enhanced SLCCM is capable of providing more accurate information than the SLCCM.

3.2 SIMPLIFICATION OF THE ENHANCED MODEL

The Enhanced SLCCM elements (or equations) were examined with the goal of simplifying the model by eliminating those elements having minimal effect on the SLCC.

3.2.1 Influence of Input Parameters

Each Enhanced SLCCM data input was varied $\pm$ 25 percent to determine its influence on the standardization life-cycle cost. Every input that changed the output results by one percent or more was examined. This process was accomplished for each of the 20 C/Es modeled.

While the sensitivity analysis was being performed for the 20 study C/Es, the element SLCC contributions obtained with the three validation

C/Es were ranked. Table 3-3 presents this ranking, showing that five elements constitute more than 90 percent of the SLCC. These five elements

Table 3-3. MODEL ELEMENTS RANKED BY SLCC CONTRIBUTION

Model Element	Average SLCC Contribution (Percent)
1. Production Hardware (Prime Equipment Acquisition)	45
2. Overhaul (Support, Follow-On)	16
3. Preventive Maintenance (Support, Follow-On)	12
4. Training (Initial Support Acquisition)	11
5. Training (Support, Follow-On)	10
6. Corrective Maintenance (Support, Follow-On)	2
7. Documentation (Initial Support Acquisition)	2
8. Document Maintenance (Support, Follow-On)	1
9. Supply Support (Support, Follow-On)	<1
10. Support and Test Equipment Acquisition (Initial Support Acquisition)	<1
11. Production Test and Equipment (Prime Equipment Acquisition)	<1
12. Facilities (Support, Follow-On)	<1
13. Government Program Management	<1
14. Production Support and Services (Prime Equipment Acquisition)	<1
15. Support and Test Equipment Maintenance (Support, Follow-On)	<1

were then examined to determine their influence on the total SLCC. Although the percentages vary from equipment to equipment, approximately 80 percent of the SLCC for each of the 20 C/Es analyzed is based on these five cost elements. These five elements, therefore, were chosen to represent the SSM. Examination of the five chosen elements yields the 37 individual cost inputs listed in Table 3-4.

Of the 37 required inputs, 24 were identified as prime inputs; they are listed in Table 3-5. The remaining 13 are standard inputs. Of the 24 prime inputs, about one-third were identified as having the individual effect of varying the total output by more than 5 percent if their input was varied by 25 percent during the sensitivity analysis. The other two-thirds have a smaller impact but still vary the total output by more than one percent.

Table 3-4. INPUT DATA REQUIRED FOR EACH MAJOR SSM ELEMENT		
Major Element	**Input Data Code**	**Input Data Description**
Prime Equipment Acquisition - Production Hardware	NN	C/E annual acceptance schedule
	CU	C/E procurement price
	AHA	Shipyard labor rate
	NHB	Hours to review SCL
	NHL	Hours for trade-off evaluation
	NHF	Hours for nonstandard C/E evaluation
	NHH	Hours to incorporate standardization specifications
	PHS	Cost per nonstandard item
	PHT	Number of nonstandard items
	Y	Number of years covered by life-cycle analysis
	YACQ	Number of years of C/E acquisition
Support (Follow-On) - Preventive Maintenance	N(I)	C/E inventory
	N	Designator for specific preventive maintenance type
	NM	Number of preventive maintenance types
	OT	C/E operating time
	LPM	Maintenance time for each type of preventive maintenance activity
	RSL	Organizational/intermediate maintenance personnel pay rate
	MPM	Material cost of each preventive maintenance type of action
	NPM	Time between inspections of each type of preventive maintenance
	Y	Number of years covered by life-cycle analysis
Support (Follow-On) - Overhaul	NOH	C/E overhaul schedule
	OHL	Overhaul maintenance time
	RSD	Depot maintenance pay rate
	OHT	Material shipping rate
	OHM	Overhaul maintenance material cost
	Y	Number of years covered by life-cycle analysis
Initial Support Acquisition - Initial Training	PTO	Number of students (operator)
	CTO	Operating personnel training cost
	PTM	Number of students (O/I maintenance)
	CTM	O/I maintenance personnel training cost
	PTP	Number of students (depot maintenance)
	CTP	Depot maintenance personnel training cost
	PTI	Number of students (instructor)
	CTI	Instructor personnel (training cost)
	ATU	Acquisition and installation costs of training aids
	Y	Number of years covered by life-cycle analysis
	YACQ	Number of years of C/E acquisition
Support (Follow-On) - Follow-On Training	CTO/CTM/ CTP	(Repeat items)
	LO	Manning level of operating personnel
	LM	Manning level of O/I maintenance personnel
	LP	Manning level of depot maintenance personnel
	RAM	Personnel attrition rate (operator and O/I maintenance)
	RAP	Personnel attrition rate (depot maintenance)
	Y	Number of years covered by life-cycle analysis

Table 3-5. SSM PRIME INPUTS	
Input Data Code	Input Data Description
NN	C/E annual acceptance schedule
CU	C/E procurement price
N(I)	C/E inventory
OT	C/E operating time
LPM	Maintenance time for each type of preventive maintenance activity
RSL	Organizational/intermediate maintenance personnel pay rate
NPM	Time between inspections of each type of preventive maintenance
NOH	C/E overhaul schedule
OHL	Overhaul maintenance time
RSD	Depot maintenance pay rate
PTO	Number of students (operator)
CTO	Operating personnel training cost
PTM	Number of students (O/I maintenance)
CTM	O/I maintenance personnel training cost
PTP	Number of students (depot maintenance)
CTP	Depot maintenance personnel training cost
PTI	Number of students (instructor)
CTI	Instructor personnel (training cost)
Y	Number of years covered by life-cycle analysis
LO	Manning level of operating personnel
RAM	Personnel attrition rate (operator and O/I maintenance)
LM	Manning level of O/I maintenance personnel
LP	Manning level of depot maintenance personnel
RAP	Personnel attrition rate (depot maintenance)

The relative importance of any of these inputs may shift in actual usage, depending on the salient features of the particular C/E being examined; for example, in a particular C/E, OHL (overhaul time) might be more influential than LPM (preventive maintenance time), or vice versa. However, it is expected that most HM&E C/E prime inputs will be found within the five elements.

3.2.2 Revision of the Enhanced Model

The SSM is made up of the portions of the SLCCM that in this study represent the major cost-driver elements in that model. These portions include the costs for hardware production, training, and C/E maintenance and overhaul.

The SSM equations are shown in Table 3-6. These are a subset of Enhanced SLCCM equations with identical definitions for each of the equation's parameters. The table provides each of the cost element names, the equation for each element, and the data input description. The total C/E life-cycle cost calculated by the SSM is the sum of these elements. As with the Enhanced SLCCM, cost subtotals are available to the user as a model output.

3.2.3 Determining Input Requirements

The input data required for use in the SSM are divided into two groups: prime data and standard data. Of the 37 required SSM inputs, 24 are prime and 13 are standard. Prime data are specific to each C/E and should be obtained for each C/E to make it possible to use the model. Standard data* do not differ from C/E to C/E and require only periodic update. C/E acquisition cost is an example of prime data; Navy salary rates are an example of standard data.

Both the Enhanced SLCCM and the SSM can be used even though some data may be missing. During this study a number of data inputs, including some prime data, were not available. Estimates were made in these cases. Some estimates were made on the basis of spare parts costing data, some by direct comparison with like C/Es, some through in-house experience with similar equipments, and some on the basis of previous experience of vendors. Using estimates in this way permits analysis of C/Es to continue while efforts to collect and refine data inputs are under way.

There are two significant advantages of the SSM:

- More than one third of the input data is of fixed value (standard data), internal to the model
- It needs less than one-half the number of data inputs required by either of the other models. The five SSM elements comprise 37 data inputs

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*Such as are available in NAVWESA's "Naval Air Systems Command Avionics Level of Repair Model, MOD III Default Data Guide," November 1978, and other documents.

Table 3-6. SIMPLIFIED STANDARDIZATION MODEL		
Element	**Equation**	**Data Input Description**
	Prime Equipment Acquisition	
Production Hardware	$\sum_{I=1}^{YACQ} NN(I) \times CU + PHB + PHC$ $+ PHF + PHH + PHR$ where YACQ = Number of years involved in C/E acquisition I = Designator for a specific project year PHB = AHA × NHB PHC = AHA × NHC PHF = AHA × NHF PHR = PHS × PHT	$\sum_{I=1}^{YACQ} NN(I) \times CU$ = Prime equipment procurement cost ($/yr) PHB = Shipyard cost to review SCL ($/yr) PHC = Shipyard cost for trade-off evaluation ($/yr) PHF = Shipyard cost for evaluation of use of non-standard C/E ($/yr) PHH = Shipyard cost to incorporate standardization specifications ($/yr) PHR = Shipyard cost to approve use of nonstandard item ($/yr) NN(I) = Prime equipment annual acceptance schedule (equipments/yr) CU = Prime equipment procurement price ($/equipment) AHA = Shipyard labor rate ($/hr) NHB = Number of hours to review SCL NHC = Number of hours for trade-off evaluation NHF = Number of hours for nonstandard C/E evaluation NHH = Number of hours to incorporate standardization specifications PHS = Cost per nonstandard item ($/item) PHT = Number of nonstandard items
	Initial Support Acquisition	
Training		
• Operator	$\sum_{I=1}^{Y} PTO(I) \times CTO$	PTO(I) = Number of students (students/yr) CTO = Operating personnel training cost ($/student)
• O/I Level Maintenance	$\sum_{I=1}^{Y} PTM(I) \times CTM$	PTM(I) = Number of students (students/yr) CTM = O/I maintenance personnel training cost ($/student)
• Depot Level Maintenance	$\sum_{I=1}^{Y} PTP(I) \times CTP$	PTP(I) = Number of students (students/yr) CTP = Depot maintenance personnel training cost ($/student)
• Instructor	$\sum_{I=1}^{Y} PTI(I) \times CTI$ where Y = Number of years in C/E life-cycle	PTI(I) = Number of students (students/yr) CTI = Instructor training cost ($/student)
• Training Aids	$\sum_{I=i}^{YACQ} ATU(I)$	ATU(I) = Acquisition and installation cost of training aids ($)

(continued)

Table 3-6. (continued)		
Element	**Equation**	**Data Input Description**
	Follow-On Support	
Preventive Maintenance • Labor	$\sum_{I=1}^{Y} N(I) \times \sum_{N=1}^{NM} \times OT \times LPM(N)$ $\times RSL/NPM(N)$ where N = Designator for a specific preventive maintenance type NM = Number of preventive maintenance types	N(I) = Prime equipment inventory (equipments/yr) OT = Prime equipment operating time (hrs/equipment/yr) LPM(N) = Maintenance time of N^{th} type preventive maintenance action (hrs/equipment/action) RSL = O/I maintenance personnel pay rate ($/hr) NPM(N) = Time between inspections of N^{th} preventive maintenance (hrs/action)
• Material	$\sum_{I=1}^{Y} N(I) \times \sum_{N=1}^{NM} \times$ $OT \times MPM(N)/NPM(N)$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) MPM(N) = Material cost of N^{th} type preventive maintenance (hrs/action) NPM(N) = Time between inspections of N^{th} preventive maintenance (hrs/action)
	Follow-On Support	
Overhaul • Labor	$\sum_{I=1}^{Y} NOH(I) \times OHL \times RSD$	NOH(I) = Prime equipment overhaul schedule (equipments/yr) OHL = Overhaul maintenance time (hrs/equipment) RSD = Depot maintenance pay rate ($/hr)
• Material	$\sum_{I=1}^{Y} NOH(I) \times OHM$	NOH(I) = Prime equipment overhaul schedule (equipments/yr) OHM = Overhaul maintenance material cost ($/equipment)
• Transportation	$\sum_{I=1}^{Y} NOH(I) \times OHT$	NOH(I) = Prime equipment overhaul schedule (equipments/yr) OHT = Material shipping rate ($/equipment)
	Follow-On Support	
Training • Operator	$\sum_{I=1}^{Y} LO(I) \times RAM \times CTO$	LO(I) = Manning level of operating personnel (personnel/yr) RAM = Personnel attrition rate (ratio) CTO = Operator training cost ($/student)
• O/I Level Maintenance	$\sum_{I=1}^{Y} LM(I) \times RAM \times CTM$	LM(I) = Manning level of O/I maintenance personnel (personnel/yr) CTM = O/I maintenance personnel training cost ($/student)
• Depot Level Maintenance	$\sum_{I=1}^{Y} LP(I) \times RAP \times CTP$	LP(I) = Manning level of depot maintenance personnel (personnel/yr) RAP = Personnel attrition rate (ratio) CTP = Depot maintenance personnel training cost ($/student)

3.2.4 Verification of Simplified Standardization Model

The total SLCC derived for a C/E (Lube Oil Filter) through use of the Enhanced SLCCM was compared with that derived through use of the SSM. The results show close correlation; the actual figures are:

- Enhanced SLCCM - $1,742,000
- SSM - $1,596,000

As expected, the SSM results are slightly lower than those obtained through the Enhanced Model.

To obtain a more complete verification, the SSM SLCCs were compared with the results available for the three C/Es used in the original SLCCM validation (*Application of the Standardization Life-Cycle-Cost Model*, December 1979, ARINC Research Publication 1863-01-1-2096). The comparison is shown in Table 3-7; more detail is presented in Appendix C. It can be seen that the SSM costs are more than 90 percent of the SLCCM costs.

Table 3-7. COMPARISON OF TOTAL SLCC FOR THREE C/Es (THOUSANDS OF DOLLARS)

C/E	SLCCM	SSM
Lube Oil Filter APL 487140001	1,742	1,596
Refrigeration Plant, A. C. APL 325010399	9,393	9,231
Compressor, L.P. Air APL 061430250C	9,061	8,628

3.3 C/E SELECTION, DATA COLLECTION, AND MODEL ANALYSIS

Twenty C/Es were selected for use in this study in addition to the three C/Es from the original SLCCM validation effort. Data were collected or engineering estimates were made for each of the CEs, and these inputs were used in the SLCCM and SSM models to determine the costs for both the standard and nonstandard configurations. These efforts are discussed in the following subsections.

3.3.1 Selection of C/Es

The 20 C/Es selected for exercise and analysis with the Enhanced SLCCM and the SSM are listed in Table 3-8. Their selection was based on the following criteria:

- Each C/E was listed in the SCL.

Table 3-8. C/Es SELECTED FOR EXERCISE WITH ENHANCED SLCCM AND SSM

Least Complex				Most Complex
Complexity Category A (0-1 APL Line Item)	Complexity Category B (2-6 APL Line Items)	Complexity Category C (7-13 APL Line Items)	Complexity Category D (14-50 APL Line Items)	Complexity Category E (More than 50 APL Line Items)
APL 109030049, Meter, Liquid, FW Disc Type, 0.750 in./75 psi, 2-8 gpm	APL 070970004, Unit Heater, Air Circulating, 440 Vac/1.5 kW	APL 016021435, Pump, Rty Pwr, 700.0 gpm/60 psi/1750 rpm	APL 060030001, Compression, Refrigeration, 580 rpm	APL 506330001, Panel-Monitor Voltage x Frequency
APL 400060902B, Fan, Centrifugal, 2000 cfm	APL 151030137, Starter Motor, Magnetic, 460 V, 1 speed, 1 winding	APL 780030009, Coupling Shaft, Flexible, Maximum Bore 1.625 Insr	APL 111610018, Power Supply, 440 Vac Input (28 Vdc optional), 0.1 kW	APL 612200051C, Console, Loader Control
APL 330200005, Motor-Pneumatic, Part No. 51886M	APL 174720568, Motor, AC, 2-Speed, 3 hp	APL 882094626, Valve, Reducing	APL 151406772C, Controller, AC, Magnetic, 440 V, 2-Speed, 2 Windings	APL 691300156X, Gear, Assembly, Speed Reducing, Main
APL 174031359B, Motor, AC, 440 V, 300 hp	APL 882182585B, Valve, Solenoid	APL 212104133, Switch	APL 016035130, Pump, Centrifugal, 230 gpm	APL 061900283, Compressor, Air

- Each C/E was identified to a distinguishable complexity category, the complexity being determined by the number of APL line items in the unit.
- Each C/E was produced by a vendor, rather than by the Government.

The first two criteria were met by examining the SCL listing that was also prepared in this study, the SCL categorization. The final criterion became apparent during review of the preliminary selections. Manufacturing rights for four of the selected C/Es were owned by the Government. These were replaced by other selections, all of which were commercially available C/Es.

The completed listing of 20 selected C/Es consists of five categories of four C/Es each. The least complex category contains C/Es with no more than one APL line item. The most complex category includes the C/Es with more than 50 APL line items.

3.3.2 Data Collection

The sources shown in Table 3-9 were used to obtain the information required for the data collection. As expected, some of the data were unobtainable, such as proprietary data or unusable data obtained from out-of-date manufacturers' catalogues. Information was available for approximately 50 percent of the data inputs; the other data inputs were estimated.

The following standard input parameter values were collected and were used for all the runs conducted for this study (in future applications of the model these standard values may also be employed):

- AAM - Annual APL Maintenance Cost. Data are based on a 1968 cost of $4.21 per APL in NAVSECMECHDIV 6834: CFC;tm 4120, Sr. 942, 3 September 1968. The annual APL maintenance cost of $11 per APL

Table 3-9. INFORMATION SOURCES

- Interviews with:
  - NAVSSES Detachment (Mechanicsburg, PA) Personnel
  - SPCC Personnel
  - NAVSUP Personnel
  - NAVMAT Personnel
  - Vendor Personnel
  - Naval Manpower Resource Center Personnel
- OPNAVINST 4441.12, Change 1, March 1975
- Air Force Regulations 76-4 and 76-11
- NAVSUPINST 4031.30, January 1973
- OPNAVINST 5330.8
- ARINC Publication 1821-11-1-1733, April 1978
- Navy Management Data List, January 1977
- Life-Cycle-Cost Guide for Equipment Analysis, NAVWESA, January 1977
- NAVSEC Report 6116D3-405-78, April 1978
- Standard Components List, October 1978
- Compendium of ICP Management Information, Vol. I, Management Data, November 1974 (DSA)
- NAVAIR Avionics Level of Repair Model, MOD-III Default Data Guide, November 1978
- DDG-47 HM&E Equipment Reliability Improvement Assessment R&M Data Study, April 1979, NAVSEA 313
- NAVELEX LOR Standard Input Data, Undated
- MRCs, Various
- MIPs, Various
- DD-963 Class APL Configuration
- Lead APLs
- APLs, specific to analyzed C/Es
- Fleet COSALS
- Technical Manuals
- Master Best Replacement Factor List
- COSAL for the USS SPRUANCE, DDG-963
- Follower APL to Lead APL Cross Reference List

is obtained by escalating the 1968 cost to a 1979 base value, then inflating the cost over the 12-year evaluation period, and, finally, averaging these costs.

- ACDP/ACP/HCP/NP - Number of Pages. Data are based on page counts of technical manuals, as well as on engineering judgments as to complexity of pages. Where technical documentation was not available, estimates were made on the basis of knowledge of similar-equipment manuals.

- CACD/CHCD - Cost per Drawing Page. Data are extrapolated from discussions with personnel associated with equipment drawings. Included are preparation, review, approval, and production expenditures associated with the drawing costs - $1,250 per page for average-complexity equipments and $2,500 per page for high-complexity equipments.

- CACP/CHCP - Cost per Technical Manual Page - Data are based on information provided by "NAVAIR Avionics Level of Repair Model, MOD-III Default Data Guide," 1 November 1978. This document indicates $338 per page for average complexity and $367 per page for high complexity.

- CST(K) - Unit Cost of K^{th} Item - Parts costs were derived from the NMDL; approximately 90 to 95 percent of parts costs are available from that source. The remaining 5 to 10 percent were estimated or extrapolated by comparison with similar parts. For nonstandard C/Es, nonstandard-parts cost information must be provided by the vendor or shipbuilder, or large-scale extrapolations and estimates must be used.

- ISSD(I) - Depot Maintenance Storage Space - Data for depot maintenance storage space were extrapolated from technical manuals and other sources. In general, the value is an average area in square feet required to store one C/E.

- CNP/PAPL - Cost to Process NSN/APL Documentation - Labor, administrative, and ADP costs were obtained from SPCC and the Air Force Logistics Command. The processing costs are nonrecurring (a one-time expense). The costs for each APL are for processing the basic document only and do not include costs for processing each line item.

- LPM(N)/NM/OHL/OHM - Maintenance Types, Periods, and Material Cost - Data regarding these inputs were derived, where available, from the appropriate Maintenance Index Pages (MIPs). If the MIP was not available, data were extrapolated from information contained within technical manuals or from similar actions for other equipment.

- NAP/NAPL/NAPS/NK - Allowance Parts List Information - Allowance Parts List Information was obtained by direct examination of each appropriate APL. In many cases, Lead APLs were referenced for required data.

- OBSA/WSAVL - On-Board and Wholesale Spares Available. Data were derived from internal calculations based on model inputs.

* OHT - Material Shipping Rate. The material shipping rate is equipment-dependent only in terms of the material's actual weight. The "NAVELEX LOR Standard Input Data" list (undated) and Air Force Regulation 76-11 provide for an estimated one-way transportation cost of $7.75; that rate was used in this study.
* OT/R(K) - Operating Time and MTBF. Information regarding the C/E operating period and MTBF was obtained from a study entitled "DDG-47 HM&E Equipment Reliability Improvement Assessment - R&M Data Sheets," dated April 1979 (NAVSEA 313). Where appropriate, DDG-47 specifications were also referred to for approximations.
* RW(K)W(K) - Weight. Weight data were obtained from the technical manuals where possible. Engineering estimates were provided in those cases where documentation was not available.

3.3.3 Analysis of the Models

Each program run for a standard C/E was paired with a similar program run for the standard C/E treated as a nonstandard. This is practical since several of the data inputs logically vary if the standard C/E is considered to be new (nonstandard) to the Government. Generally, the variation will be caused by the entering of a zero cost for certain data inputs to standard C/E elements where the same data inputs would have some value if the C/E were nonstandard; for example, the cost to prepare an APL for a standard C/E would be zero (the APL already exists -- it was paid for at the time the C/E became a standard Navy article), but a value would be entered for preparation of an APL for a nonstandard C/E. In other cases, the cost input is merely lower for the standard C/E data input; for example, the cost of initial operator training will often be lower for the standard C/E. In a few cases, the data input cost for a standard C/E may exceed that of a nonstandard; for example, the production hadware cost used in this analysis was 10 percent lower for the nonstandard C/E.

Through use of these differentials, it is relatively simple to derive a cost difference between a standard C/E and a similar nonstandard C/E. Since the selected C/Es are all standard equipments, the desired result was obtained by first acquiring an SLCC and then processing the C/E again as though it were nonstandard. A routine in the program then established the cost differences between nonstandard and standard C/Es. Appendix D is a sample computer output of Enhanced SLCCM and SSM program runs. Appendix E provides the complete listing of standardization costs obtained for all study C/Es through exercise of both the Enhanced SLCCM and the SSM.

Table 3-10 summarizes the standardization costs and differences in cost between the standard and nonstandard C/E derived by using first the Enhanced Model and then the Simplified Model. The variance between the differences (standard versus nonstandard) and the ratio of the differences for each C/E are also presented. Since the values obtained by using the Enhanced Model are assumed to be accurate, they can be used as a basis for comparing the values obtained by the Simplified Model. The differences between standard and nonstandard C/E are dependent on the standardization life-cycle costs; that is the differences generally increase with the cost. These differences are also

Table 3-10. SUMMARY OF STANDARDIZATION COSTS (THOUSANDS OF DOLLARS)

C/E	APL	SLCC - Enhanced Model			SLCC - Simplified Model			Variance*	Ratio**
		Standard	Nonstandard	Difference	Standard	Nonstandard	Difference		
Meter, Liquid	109030049	44	53	+ 9	37	38	+ 1	8	9.00
Fan, Centrifugal	400060902B	86	98	+ 12	61	62	+ 1	11	12.00
Motor, Pneumatic	330200005	234	270	+ 36	193	204	+ 11	25	3.27
Motor, 440 Vac	174031359B	303	310	+ 7	287	283	- 4	11	—
Unit Heater, Air	070970004	745	825	+ 80	686	691	+ 5	75	16.00
Starter Motor	151030137	62	75	+ 13	54	56	+ 2	11	6.50
Motor, AC, 2-Speed	174720568	101	119	+ 18	84	89	+ 5	13	3.60
Valve, Solenoid	882182585B	67	85	+ 18	58	65	+ 7	11	2.57
Pump, Rotary	016021435	782	869	+ 87	671	710	+ 39	48	2.23
Coupling Shaft	780030009	57	67	+ 10	46	48	+ 2	8	5.00
Valve, Reducing	882094626	53	72	+ 19	43	50	+ 7	12	2.71
Switch, Selector	212104133	9	15	+ 6	5	5	0	6	—
Compressor, Refrigeration	060030001	153	185	+ 32	126	144	+ 18	14	1.78
Power Supply	111610018	180	210	+ 30	147	161	+ 14	16	2.14
Controller, AC	151406772C	519	577	+ 58	467	503	+ 36	22	1.61
Pump, Centrifugal	016035130	965	1057	+ 92	837	866	+ 29	63	3.17
Panel, Monitor	506330001	606	646	+ 36	575	595	+ 20	16	1.80
Console, Control	612200051C	1715	1874	+159	1532	1579	+ 47	112	3.38
Gear Assembly	691300156X	19151	20102	+951	14047	13191	-856	1807	—
Compressor	061900283	1249	1381	+132	1202	1276	+ 74	58	1.78

*The Enhanced Model difference ($Diff_{ENH}$) minus the Simplified Model difference ($Diff_{SSM}$).
**$Diff_{ENH}/Diff_{SSM}$.

generally smaller when the Simplified Model rather than the Enhanced Model is used. Exceptions are the two C/Es for which the difference between standard and nonstandard was negative and for the C/E for which the difference was zero.

Table 3-11 lists the results of additional analysis of model results. It presents the costs of Production Hardware, Production Test and Equipment, Support and Test Equipment Acquisition, and Supply Support, and the percentage of the standard C/E LCC as determined by the Enhanced Model. As shown in the table, the production hardware costs vary from 3.5 percent of the standard C/E LCC to over 50 percent. Comparison of this table with Table 3-10 indicates that those C/Es with high relative production hardware costs are also the same C/Es with large variances between model cost differences and those C/Es with a negative difference value. Figure 3-5 plots the variance between the differences of the model as a function of production hardware costs. It clearly shows that the variance increases as the production hardware cost increases. The other cost categories shown in Table 3-11 show a relatively constant contribution of the Production Test and Equipment costs, i.e., less than 4 percent; the contribution of the cost of Support and Test Equipment Acquisition ranges from zero to 25 percent; and the contribution of the Supply Support cost element ranges from zero to 12 percent.

Table 3-12 presents the total variance of the differences between the standard and nonstandard C/E obtained by using the Enhanced and the Simplified Models. This table shows the relative contribution to the variance of the Production Test and Equipment, Support and Test Equipment Acquisition, and Supply elements. These cost elements, not included in the Simplified Model are ordinarily insignificant (see Table 3-3). However, as shown in Table 3-12, they can at times account for a significant increase in LCC cost when the nonstandard C/E is selected.

3.3.4 Use of the Standardization Life-Cycle-Cost Model

Each of the life-cycle-cost models is divided into separate elements with each cost element derived by a separate model equation. The possible trade-offs available to the Navy for system design purposes are related to these individual element costs as well as to the overall cost differential between standard and nonstandard C/Es. Such element data are provided by the Enhanced SLCCM for all elements. The SSM provides data only for its constituent five cost elements. Regardless of which model is employed, the available element SLCC differences can be used for trade-offs (SLCC element differences for the 20 C/Es examined are given in Appendix E). With this kind of information in hand, a ship acquisition manager might be able to make trade-offs, for example, between higher acquisition costs and a guaranteed lower mean time to repair (MTTR), or between higher reliability and less easily accessible test points. The probable trade-offs would be limited only by the goals of the participants in the negotiation and by the possible impact of each trade-off on other aspects of the ship acquisition.

This study shows that in most cases the major contributors to overall SLCC differences are the five elements that constitute the SSM. The Production Test and Equipment element, which on the average ranked eleventh of 15 in terms of

Table 3-11. RELATIVE COST CONTRIBUTION OF SELECTED COST ELEMENTS TO THE STANDARD C/E LCC USING THE ENHANCED MODEL

C/E	APL	Enhanced Model SLCC - STD C/E	Production Hardware		Production Test and Equipment		Support and Test Equipment Acquisition		Supply Support	
			Cost ($ Thousands)	Percentage of C/E	Cost ($ Thousands)	Percentage of C/E	Cost ($ Thousands)	Percentage of C/E	Cost ($ Thousands)	Percentage of C/E
Meter, Liquid	109030049	44	2	4.5	1	2.3	1	2.3	-	-
Fan, Centrifugal	400060902B	86	16	18.6	2	2.3	-	-	-	-
Motor, Pneumatic	330200005	234	21	9.0	5	2.1	-	-	27	11.5
Motor, 440 Vac	174031359B	303	147	48.5	2	0.7	1	0.3	1	0.3
Unit Heater, Air	070970004	745	345	46.3	17	2.3	1	0.1	22	3.0
Starter Motor	151030137	62	6	9.7	1	1.6	-	-	-	-
Motor, AC, 2-Speed	174720568	101	24	23.8	2	2.0	7	6.9	-	-
Valve, Solenoid	882182585B	67	[illegible]	7.5	1	1.5	1	1.5	2	3.0
Pump, Rotary	016021435	782	345	44.1	7	0.9	17	2.2	5	0.6
Coupling Shaft	780030009	57	12	21.1	1	1.8	3	5.3	-	-
Valve, Reducing	882094626	53	6	11.3	2	3.8	-	-	1	1.9
Switch, Selector	212104133	9	1	11.1	-	-	-	-	-	-
Compressor, Refrigeration	060030001	153	8	5.2	1	0.7	1	0.7	-	-
Power Supply	111610018	180	21	11.7	2	1.1	-	-	1	0.6
Controller, AC	151406772C	519	35	6.7	4	0.8	3	0.6	13	2.5
Pump, Centrifugal	016035130	965	414	42.9	35	3.6	20	2.1	2	0.2
Panel, Monitor	506330001	606	21	3.5	5	0.8	1	0.2	2	0.3
Console, Control	612200051C	1,715	431	25.1	17	1.0	93	5.4	22	1.3
Gear Assembly	691300156X	19,151	10,399	54.3	35	1.8	4,741	24.8	70	0.4
Compressor	061900283	1,249	311	24.1	9	0.7	26	2.1	-	-

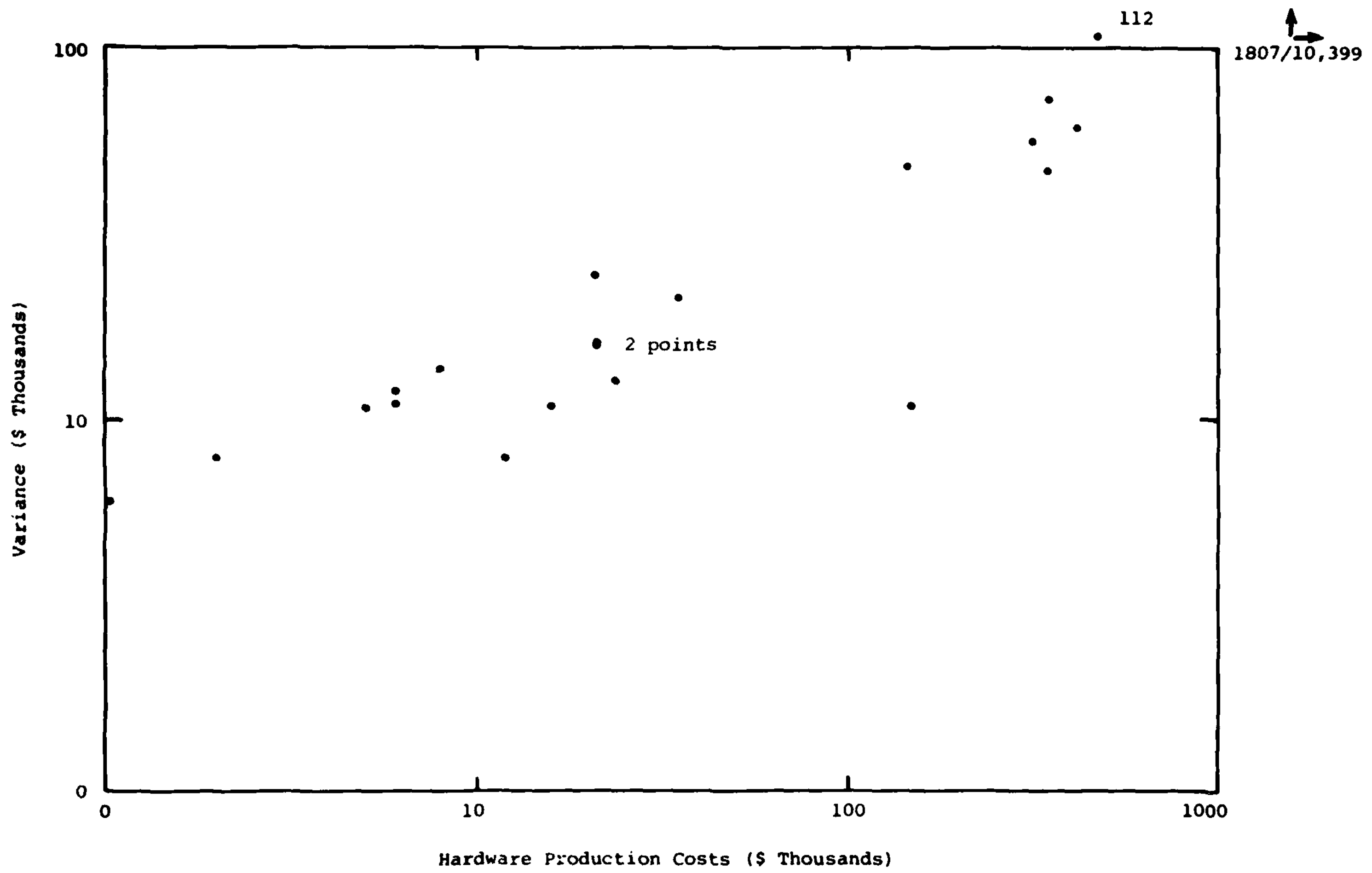

Figure 3-5. MODEL DIFFERENCE VARIANCE AS A FUNCTION OF HARDWARE PRODUCTION COSTS

Table 3-12. VARIANCE OF MODEL DIFFERENCES BETWEEN STANDARD AND NONSTANDARD C/Es (THOUSANDS OF DOLLARS)

C/E	APL	Total	Production Test and Equipment	Support and Test Equipment Acquisition	Supply Support	Other
Meter, Liquid	109030049	8	3	--	4	1
Fan, Centrifugal	400060902B	11	5	1	4	1
Motor, Pneumatic	330200005	25	17	1	6	1
Motor, 440 Vac	174031359B	11	0	6	4	1
Unit Heater, Air	070970004	75	53	14	6	2
Starter Motor	151030137	11	5	1	4	1
Motor, AC, 2 Speed	174720568	13	6	2	4	1
Value, Solenoid	882182585B	11	5	1	4	1
Pump, Rotary	016021435	48	23	17	4	4
Coupling Shaft	780030009	8	3	0	4	1
Valve Reducing	882094626	12	6	1	3	2
Switch, Selector	212104133	6	1	0	4	1
Compressor, Refrigeration	060030001	14	7	0	4	3
Power Supply	111610018	16	7	3	4	2
Controller, AC	151406772C	22	13	2	5	2
Pump, Centrifugal	016035130	63	38	18	4	3
Panel, Monitor	506330001	16	8	1	4	3
Console, Control	612200051C	112	43	59	6	4
Gear Assembly	691300156X	1,807	110	1,662	11	24
Compressor	061900283	58	28	22	4	4

contribution to the standardization life-cycle cost, can often appear to be a major contributor in the Enhanced SLCCM. It is emphasized that individual differences in a particular C/E analyzed, such as the use to which it is put, might cause any model element cost to become dominant. The cross section of C/Es employed in this study indicates that the elements used in the SSM will continue to be the major contributors for the majority of the HM&E C/Es.

The analysis was based on 20 samples distributed across all complexity categories. Care should be used when the Simplified Model is used since the 20 samples do not represent the total universe of possible C/Es and, although representative, some data inputs had to be estimated. The following criteria should be employed when the simplified model is being used:

- The SSM should be used as an indicator of the relative life-cycle costs and differences between these costs for standard and nonstandard C/Es.
- If the life-cycle-cost difference between the standard C/E and nonstandard C/E is very close to zero (or is a minus difference) the Enhanced Model should be used.
- If the production hardware costs are large compared with the standardization life-cycle cost of the C/E, the Simplified Model may not provide reliable results, and use of the Enhanced Model is indicated.

Apart from program-system acquisition concerns (e.g., potential increases in C/E effectiveness, acquisition schedules, C/E and spare parts availability), either model's total SLCC differential may be employed simply as a go/no-go indicator for the approval of nonstandard C/Es; i.e., if the nonstandard C/E standardization cost to the Navy is more than the standard C/E cost, then approval for use of the nonstandard C/E would not be indicated. That differential might also be employed by the Navy as a tool to obtain some overall consideration from the contractor in return for his receiving approval to use a nonstandard C/E. In some applications the Navy might consider granting blanket approval for use of nonstandard equipment whenever the standardization life-cycle-cost differential is favorable for those C/Es.

The models, particularly the Enhanced SLCCM, have a potential further use to the Navy with regard to selection of HM&E C/Es. In place of or in addition to formal specifications, the models might provide C/E cost goals for contractors. If a standard C/E were modeled, then modeled again with changes considered important to the Navy, the comparative results could become the basis for an acquisition incentive program. That is, the results would provide contractors with a baseline to work from -- the "measure" against which the Navy will make judgments -- and an opportunity to reduce costs in other elements to obtain an equal or lower total SLCC than required by Navy goals.

3.4 STANDARD COMPONENTS LIST CATEGORIZATION

The SCL was categorized to aid users in locating and selecting C/Es. The principal components of the SCL were separated into functional HM&E categories based on ship work breakdown structure identifiers:

- Deck and Hull machinery
- Fluid Systems
- Refrigeration/Heating Systems
- Electrical Systems

In addition, the complexity of each representative C/E was determined by a count of its APL line items. A subjective analysis of the comparative ease of locating desired C/Es in the SCL was then performed.

Since the objective of the categorization was to provide a method that would facilitate location of C/Es in the document, it was decided to concentrate on the SCL Nomenclature Index. (Upon consideration, reorganization of the body of the SCL was discarded as being of limited value, unless it is decided to add data not now included.) A sample portion of the existing SCL Nomenclature Index is represented in Figure 3-6.

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NOMENCLATURE INDEX

-------------------- NOMENCLATURE -------------------	PAGE-NO
HOIST-CHAIN, PORTABLE	477
HOIST-CHAIN, ELECTRIC HOOK	477
HOIST-CHAIN, ELECTRIC PLAIN	478

Figure 3-6. EXISTING SCL NOMENCLATURE INDEX, SAMPLE PORTION

A reorganization of this index that includes the information regarding SWBS category and complexity category for representative C/Es is believed to be a relatively easy and effective means of achieving the task objective.

As can be seen in Figure 3-6, the existing index provides no more than a brief name identifier for each C/E, plus the number of the page in the SCL on which data may be found. The user must often examine many SCL entries after use of the index to locate the desired C/E (as a worst-case example of the information that must be examined, there are more than 170 entries for Valves, covering more than 700 pages in the SCL). A cursory

analysis shows that it would not be cost-effective to expand the index to permit direct location of the desired C/E in all cases. To do so would require an index expansion that could begin to approach the size of the overall SCL. Instead, the index was categorized to assist the user in locating the desired C/E in fewer trials, which will be a perceptible aid in the C/E selection process.

After various attempts to arrange the information now available, it was determined that the format illustrated in Figure 3-7 (and followed through in the SCL categorization provided in Appendix F) was most appropriate. This determination was made by the study investigators after comment was solicited from and discussions held with appropriate NAVSEA personnel. It will be observed in Figure 3-7 that the only modification to the existing SCL Nomenclature Index consists of the addition of two columns of information, i.e., HM&E WBS category and Complexity Category. Analysis showed that changing the alphabetic nomenclature ordering of the index (for example, ordering it by APL number) would be counterproductive in terms of ease of C/E location. Therefore, the existing scheme was left intact; only the small quantity of supplemental information was added.

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NOMENCLATURE INDEX

Nomenclature	HM&E WBS Category	Complexity Category	Page Number
Hoist-Chain, Portable	Deck and Hull Machinery	B	477
Hoist-Chain, Electric Hook	Deck and Hull Machinery	C	477
Hoist-Chain, Electric Plain	Deck and Hull Machinery	D	478

Figure 3-7. SAMPLE SCL NOMENCLATURE INDEX, RECOMMENDED FORMAT

As an addition to the data provided by the current SCL index, the supplemental information is expected to assist the user in several ways:

- The description of the generic system will enable the user to eliminate C/Es that are employed in other than the application desired. Example: Rather than an examination of more than 50 pages of "Indicators" for a heating system, reference to the HM&E WBS category column might reduce the number of pages to two.

- With the indication of the range of APL line items in groups of like SCL C/Es, the user may find it beneficial to dismiss from his C/E search those equipments obviously more or obviously less complex than is called for by the intended application. Example: Given a choice of "Valve-Safety Relief" candidate C/E types that fall into complexity categories A, B, and D, the user/designer may, without further thought, eliminate all valves with only a single repair part (complexity category A) as not meeting his requirements.
- Given knowledge of the price of a particular C/E described within the SCL, the user may make a judgment that the price of another C/E in the same group, and falling within the same HM&E WBS category and complexity category, is similar to the original C/E.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

4.1 THE ENHANCED STANDARDIZATION LIFE-CYCLE-COST MODEL

The Enhanced SLCCM (for HM&E equipments) provides more detailed cost predictions than the original SLCCM because it incorporates a new sparing routine. The Enhanced SLCCM can be of significant value in the acquisition of C/Es by assisting in the trade-off analysis of acquiring either standard or nonstandard items. It is particularly useful in the analysis of high-value complex C/Es and where production test and equipment (cost element) costs are quoted separately from production hardware costs.

It is recommended that the Enhanced SLCCM replace the SLCCM for standardization modeling activities and that future reference to the "SLCCM" be understood to refer to the Enhanced Model. It is further recommended that the Enhanced SLCCM be used by agents responsible for the acquisition of HM&E C/Es to assist in technical, cost, and other acquisition decisions.

4.2 THE SIMPLIFIED STANDARDIZATION MODEL

The SSM, developed by eliminating equations from the Enhanced SLCCM, can be used more quickly and easily than the Enhanced SLCCM, but it is not as accurate or as comprehensive. The SSM provides similar indicators of relative life-cycle costs and differences for standard and nonstandard HM&E C/Es, except in some cases where production hardware costs are very large or where the difference between standard and nonstandard life-cycle costs is very small.

It is recommended that the SSM be used, where applicable, in standardization analyses when it is important to obtain SLCC comparisons quickly and easily and accuracy and level of detail are not of prime importance.

4.3 ADDITIONAL DEVELOPMENT

The ability to change inputs to a standardization model rapidly and conveniently and to obtain an output SLCC quickly would encourage the use of the SSM. It is recommended that the SSM be adapted for use on a desk-top

programmable calculator. Programmable calculators that would be candidates for this application may be available from commercial United States manufacturers by late 1980.

The SLCCM work of this and previous studies has concentrated on Hull, Mechanical, and Electrical (HM&E) components or equipments (C/E). Some of this work may have application in non-HM&E areas. It is recommended that a study be conducted to investigate this applicability.

4.4 THE STANDARD COMPONENTS LIST

The Standard Components List (SCL) is more readily categorized by applying a relatively simple format change to include HM&E and complexity categories. It is recommended that these changes be made. Because of their simplicity these changes could readily be accomplished through simple processing when the SCL was due for revision.

APPENDIX A

DETERMINATION OF ON-BOARD REPAIR PARTS AND SYSTEM STOCK PARTS

This appendix describes the methodology for determining the repair parts required for C/Es to be exercised with the Enhanced SLCCM. (Although the described methodology follows general SPCC sparing procedures, the actual procedures entail more precise usage and encompass more detail than was deemed applicable to this study.)

COMPUTATION OF ON-BOARD REPAIR PARTS (OBRP)

1. Obtain Forms 4786 (identifies nonstandard C/E) and 4786 (identifies nonstandard C/E parts) from shipbuilder. These forms are part of the shipbuilder/vendor request for approval of the nonstandard C/E.

2. From Form 4786, identify the nonstandard C/E in as much detail as possible (example: Pump-Centrifugal/150 psi).

3. Through use of the Lead Allowance Parts List (LAPL) index, identify the LAPL number of the kind of equipment/component for which data are sought (example: 01 refers to pumps). Then, using the latter portion of the LAPL index, identify the number of the type of that equipment (example: 01-011 refers to a class of centrifugal pumps). The combination of these two numbers is the APL number, e.g., 01-011.

4. Locate the LAPL. Identify the LAPL parts that match those contained in From 4786A. Any 4786A listed item with a blank in the Allowance Factor Code column will not be provisioned for OBRP. The MEC (essentiality code) column must be 1 or 3 to be considered for provisioning. When 0 appears in Allowance Factor Code Column for TOR (allowance override code), the item is not provisioned.

5. Perform OBRP computation through use of the following definitions and instructions:

   - Mean μ - Expected demand for 90-day protection period.
   - R/F - Replacement factor expressed in terms of a year; find R/F for each item on LAPL at TRF column.

- TOR - Technical Override; find TOR on LAPL at Allowance Factor Code column, TOR is also known as Allowance Override.
  - TOR of 0 - not allowed as OBRP
  - TOR of C and D - permit OBRP when $\geq$ 0.0625 FSLIP
  - TOR of M or S - require OBRP in multiples of MRU
- MRU - Minimum replacement unit; find MRU on LAPL at MRU column.
- HIMEC - Vital to equipment/component mission; find HIMEC on LAPL at MEC column.
- SUM of PMR Override - Planned maintenance requirement override; rarely used because of unavailability; use when available.
- AQ - Allowance quantity; find AQ in Table A-1 at APL QTY column.
- POP - Quantity in one C/E $\times$ quantity of C/E per ship; find POP on Form 4786:

(a) $= \frac{POP \times R/F}{4} = \frac{X}{4} =$ ____________

(b) After solving for μ, determine APL allowance quantity by using Table A-1

(c) If $\mu \geq 1$, pick highest quantity:

1. Allowance Quantity
2. MRU
3. Sum of PMR Override
4. TOR/AOR

(d) If $\mu < 1$, pick highest quantity:

1. MRU
2. Sum of PMR Override

SYSTEM STOCK DETERMINATION

The methodology provided in SPCCINTINST 4400.30C, August 1977, for system stock determination was also adapted for use in the Enhanced SLCCM. Basic SPCC determination is made by employing two worksheets. The first is called "TWAMP Calculation Worksheet".* It provides a monthly demand averaged over a time base, and is inputted to a second worksheet, the "Wholesale Stock Determination Worksheet". This worksheet is used to provide system Stock quantities for SPCC-managed items. Detailed information on the use of these worksheets is provided in SPCCINTINST 4400.30C. Information available in that document was used in the model to determine system stock subsequent to calculation of OBRP. For this study, the worksheets and details of their use were translated into the methodology shown in Figure 3-4 of Chapter Three of this report.

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*TWAMP = Time-Weighted Average Monthly Program

TABLE A-1 FLSIP APL Quantity Table*

(Based on $\frac{\text{Annual Replacement Factor} \times \text{Item Population}}{4}$ $\frac{\text{RF} \times \text{POP}}{4}$)

$\frac{\text{RF x POP}}{4}$	APL QTY	$\frac{\text{RF x POP}}{4}$	APL QTY
		24.7 - 25.5	32
		25.6 - 26.4	33
.0625 -	0)	26.5 - 27.3	34
.0625 - .999	**)	27.4 - 28.1	35
1.0 - 1.1	2	28.2 - 29.0	36
1.2 - 1.7	3	29.1 - 29.9	37
1.8 - 2.4	4	30.0 - 30.8	38
2.5 - 3.1	5	30.9 - 31.7	39
3.2 - 3.8	6	31.8 - 32.6	40
3.9 - 4.6	7	32.7 - 33.5	41
4.7 - 5.4	8	33.6 - 34.4	42
5.5 - 6.2	9	34.5 - 35.3	43
6.3 - 7.0	10	35.4 - 36.2	44
7.1 - 7.8	11	36.3 - 37.1	45
7.9 - 8.6	12	37.2 - 38.0	46
8.7 - 9.4	13	38.1 - 39.0	47
9.5 - 9.9	14	39.1 - 39.9	48
10.0 - 10.7	15	40.0 - 40.8	49
10.3 - 11.6	16	40.9 - 41.7	50
11.7 - 12.4	17	45.0	54
12.5 - 13.3	18	50.0	60
13.4 - 14.1	19	55.0	65
14.2 - 15.0	20	60.0	70
15.1 - 15.8	21	65.0	76
15.9 - 16.7	22	70.0	81
16.8 - 17.6	23	75.0	87
17.7 - 18.4	24	80.0	92
18.5 - 19.3	25	85.0	97
19.4 - 20.2	26	90.0	103
20.3 - 21.1	27	95.0	108
21.2 - 21.9	28	100.0	113
22.0 - 22.8	29	>100.0	***
22.9 - 23.7	30		
23.8 - 24.6	31		

*This table was extracted from SPCCINTINST 4400.30C, dated August 1977.

**These items are insurance items and are allowed only if the part-to-component MEC is vital (HIMEC) and if the C/E itself is vital. If the MEC is vital, the item is allowed in a quantity of one (1) or one minimum replacement unit.

***If the mean $\frac{(\partial RF \text{ X } POP)}{(\quad 4 \quad)}$ is greater than 100.0, the allowance quantity can be computed as: Allowance = Mean + 1.28 $\sqrt{\text{Mean}}$

APPENDIX B

ENHANCED STANDARDIZATION LIFE-CYCLE-COST MODEL

The Enhanced SLCCM originated in the life-cycle-cost model developed by NAVWESA for NAVMAT. The NAVMAT model was used to develop a life-cycle-cost model for standardization. Since standardization is concerned only with the difference between standard and nonstandard C/Es, several of the NAVMAT model cost elements were eliminated, mainly in the area of research and development. The derived model became the Standardization Life-Cycle-Cost Model, which because of the cost element omissions provides a standardization life-cycle cost (but not a total life-cycle cost). The model equations described in Table B-1 are the same as those of the Standardization Life-Cycle-Cost Model, with one exception. That exception involves the incorporation of sparing routines for both on-board spares and wholesale stock spares in lieu of the formerly included spares estimating equation. In Table B-1, the portion of the Enhanced SLCCM shown enclosed within the dashed-line box represents this revised sparing method. It directly replaces the equation formerly employed by the original SLCCM.

Table B-1. EQUATIONS FOR ENHANCED STANDARDIZATION PROGRAM LIFE-CYCLE-COST MODEL		
Cost Element	**Equation**	**Cost Factor Description**
Government Program Management		
Government Program Management	$\sum_{I=1}^{Y}$ PMGG(I) + $\sum_{I=1}^{Y}$ PMGH(I) + $\sum_{I=1}^{Y}$ PMGI(I) + $\sum_{I=1}^{Y}$ PMGJ(I) + $\sum_{I=1}^{Y}$ PMGK(I) + $\sum_{I=1}^{Y}$ PMGL(I) + $\sum_{I=1}^{Y}$ PMGM(I) where I = Designator for a specific project year Y = Number of years covered by the life-cycle-cost analysis PMGG(I) = LBB × HRG PMGH(I) = LBC × HRH PMGI(I) = LBE × HRI PMGJ(I) = LBE × HRJ PMGK(I) = LBB × HRK PMGL(I) = HRN × NAP PMGM(I) = LBE × HRM	PMGG(I) = SHAPM evaluation of C/E selection ($/yr) PMGH(I) = NAVSEA evaluation of C/E selection ($/yr) PMGI(I) = SUPSHIP evaluation of C/E selection ($/yr) PMGJ(I) = SUPSHIP documentation review ($/yr) PMGK(I) = SHAPM review of system, test, and training documentation ($/yr) PMGL(I) = NAVSEA review of system and test documentation ($/yr) PMGM(I) = SUPSHIP approval of nonstandard item ($/yr) LBB = SHAPM labor rate ($/hr) LBC = NAVSEA labor rate ($/hr) LBE = SUPSHIP labor rate ($/hr) HRG = Number of hours (hr) HRH = Number of hours (hr) HRI = Number of hours (hr) HRJ = Number of hours (hr) HRK = Number of hours (hr) HRM = Number of hours (hr) HRN = Review cost per APL ($/APL) NAP = Number of APLs (APLs)
Prime Equipment Acquisition		
Production Hardware	$\sum_{I=1}^{YACQ}$ NN(I) × CU + PHB(I) + PHC(I) + PHF(I) + PHH(I) + PHR(I) where YACQ = Number of years involved in C/E acquisition PHR = AHA × NHB PHC = AHA × NHC PHF = AHA × NHF PHH = AHA × NHH PHR = PHS × PHT	$\sum_{I=1}^{YACQ}$ NN(I) + CU = Prime equipment procurement cost ($/yr) PHB = Shipyard cost to review SCL ($/yr) PHC = Shipyard cost for trade-off evaluation ($/yr) PHF = Shipyard cost for evaluation of use of nonstandard C/E ($/yr) PHH = Shipyard cost to incorporate standardization specifications ($/yr) PHR = Shipyard cost to approve use of nonstandard item ($/yr) NN(I) = Prime equipment annual acceptance schedule (equipment/yr) CU = Prime equipment procurement price ($/equipment) AHA = Shipyard labor rate ($/hr) NHB = Number of hours (hr) to review SCL NHL = Number of hours (hr) for trade-off evaluation NHF = Number of hours (hr) for nonstandard C/E evaluation NHH = Number of hours (hr) to incorporate standardization specifications PHS = Cost per nonstandard item ($/item) PHT = Number of nonstandard items (items)

(continued)

Table B-1. (continued)

Cost Element	Equation	Cost Factor Description
Prime Equipment Acquisition (continued)		
Production Support and Services	$\sum_{I=1}^{Y} PSS(I)$	$PSS(I)$ = Production support and services cost (\$/yr)
Production Test and Evaluation	$\sum_{I=1}^{Y} PTE(I) = \sum_{I=1}^{Y} EPT(I) + \sum_{I=1}^{Y} TD(I) + \sum_{I=1}^{Y} RTD(I)$	$\sum_{I=1}^{Y} EPT(I)$ = Equipment production test costs (\$/yr) $\sum_{I=1}^{Y} TD(I)$ = Test documentation cost (\$/yr) $\sum_{I=1}^{Y} RTD(I)$ = Shipyard cost to review test documentation (\$/yr)
	$EPT(I) = PTC(I) \times PTE(I)$ $TD(I) = PPC(I) \times TDP(I)$ $RTD(I) = AHA \times HRT(I)$	$PTC(I)$ = Cost to test each item (\$/item) $PTE(I)$ = Number of items tested (items/yr) $PPC(I)$ = Cost per page of test documentation (\$/page) TDP = Number of pages of test documentation (pages/yr) AHA = Shipyard labor rate (\$/hr) $HRT(I)$ = Number of hours to review test documentation (hr/yr)
Initial Support Acquisition		
Support and Test Equipment Acquisition	$\sum_{I=1}^{Y} STE(I)$	$STE(I)$ = Support and test equipment acquisition costs (\$/yr)
• Initial Spares - Prime Equipment	$\sum_{I=1}^{YACQ} (NN(I)$ [illegible] $N(YACQ$ [illegible] $SPRCST$ where $YACQ$ = Number of years [illegible] in [illegible] acquisition	$NN(I)$ = Prime equipment annual acceptance schedule (equipment/yr) $N(YACQ)$ = Maximum C/E inventory quantity (equipments) $SPRCST$ = Total cost for required spares (as determined by sparing routines modeling SPCC process described in 3.1.2)
• Support and Test Equipment	$\sum_{I=1}^{Y} STE(I$ [illegible] TEM	$STE(I)$ = Support and test equipment acquisition cost (\$/yr) TEM = Material support rate; percent of S&TE cost (ratio)
• APL Entry Into the Supply System	$\sum_{I=1}^{Y} NAPI$ [illegible] $+ \sum_{I=1}^{Y}$ [illegible] $\times (NAP + NAPS)$	[illegible] = [illegible] t to prepare APL (\$/APL) [illegible] = Cost to process APL line item (\$/item) $NAPI$ = Number of APL line items (line item) NAP = Number of APLs for prime equipment (APL) $NAPS$ = Number of APLs for support and test equipment (APL)
• NSN Entry Into the Supply System	$\sum_{I=1}^{Y} (NSNP + NSNS) \times CNP$	$NSNP$ = Number of new NSNs of primary equipment (NSN) $NSNS$ = Number of new NSNs of support and test equipment (NSN) CNP = Cost to process new NSN (\$/NSN)

(continued)

Table B-1. (continued)		
Cost Element	**Equation**	**Cost Factor Description**
	Initial Support Acquisition (continued)	
Documentation • Acquisition	$\sum_{I=1}^{Y} \text{CACP} \times \text{ACP} + \sum_{I=1}^{Y} \text{CHCP}$ $\times \text{HCP} + \sum_{I=1}^{Y} \text{CACD} \times \text{ACDP} +$ $\sum_{I=1}^{Y} \text{CHCD} \times \text{HCDP}$	CACP = Cost per page for average complexity technical manual ($/page) ACP = Number of pages of average complexity technical manual (pages) CHCP = Cost per page for high complexity technical manual ($/page) HCP = Number of pages of high complexity technical manual (pages) CACD = Cost for average complexity drawings ($/drawing) ACDP = Number of average complexity drawings (drawings) CHCD = Cost for high complexity drawings ($/drawing) HCDP = Number of high complexity drawings (drawings)
• Reproduction and Distribution	$\sum_{I=1}^{Y} \text{NC(I)} \times \text{NP} \times \text{CP}$	NC(I) = Number of copies (copies/yr) NP = Number of pages in a set of technical data (pages) CP = Reproduction and distribution costs ($/page/copy)
Training • Operator	$\sum_{I=1}^{Y} \text{PTO(I)} \times \text{CTO}$	PTO(I) = Number of students (students/yr) CTO = Operating personnel training cost ($/student)
• O/I Level Maintenance	$\sum_{I=1}^{Y} \text{PTM(I)} \times \text{CTM}$	PTM(I) = Number of students (students/yr) CTM = Operating personnel training cost ($/student)
• Depot Level Maintenance	$\sum_{I=1}^{Y} \text{PTP(1)} \times \text{CTP}$	PTP(I) = Number of students (students/yr) CTP = Depot maintenance personnel training costs ($/student)
• Instructor	$\sum_{I=1}^{Y} \text{PTI(I)} \times \text{CTI}$	PTI(I) = Number of students (students/yr) CTI = Instructor training costs ($/student)
• Training Aids	$\sum_{I=1}^{Y} \text{ATU(I)}$	ATU(I) = Acquisition and installation costs of training aids
	Follow-On Support	
Corrective Maintenance • Labor •• O/I Level (Remove and Replace)	$\sum_{I=1}^{Y} \text{N(I)} \times \sum_{K=1}^{NK} \text{OT} \times \text{DC(K)}$ $\times \text{QTY(K)} \times \text{LSO(K)} \times \text{RSL/[R(K)}$ $\times \text{FR(I)]}$ where NK = Number of repair items in C/E K = Designator for a specific repair item	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (quantity/item) LSO(K) = O/I maintenance time to remove, replace K^{th} item (hrs/item) RSL = O/I maintenance personnel pay rate ($/hr) R(K) = Mean time between failures for K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)

(continued)

Table B-1. (continued)

Cost Element	Equation	Cost Factor Description
	Follow-On Support (continued)	
Corrective Maintenance (continued) • Labor •• O/I Level (Repair)	$\sum_{I=1}^{Y} N(I) \times \sum_{K=1}^{NK} OT \times DC(K)$ $\times QTY(K) \times LSI(K) \times RSL \times RSS(K)$ $\times [1-DSC(K)]/[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (quantity/item) LSI(K) = O/I maintenance time to repair the K^{th} item (hrs/item) RSL = O/I maintenance personnel pay rate ($/hr) RSS(K) = Repair level ratio (ratio) DSC(K) = Discard rate of K^{th} item (ratio) R(K) = Mean time between failures of K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)
•• Depot Level (Repair)	$\sum_{I=1}^{Y} N(I) \times \sum_{K=1}^{NK} OT \times DC(K)$ $\times QTY(K) \times LSD(K) \times RSD \times [1-RSS(K)]$ $\times [1-DSC(K)]/[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (quantity/item) LSD(K) = Depot maintenance time to repair K^{th} item (hrs/item) RSD = Depot maintenance personnel pay rate ($/hr) RSS(K) = Repair level ratio (ratio) DSC(K) = Discard rate of K^{th} item (ratio) R(K) = Mean time between failures of K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)
• Repair Material	$\sum_{I=1}^{Y} N(I) \sum_{K=1}^{NK} OT \times DC(K)$ $\times QTY(K) \times CST(K) \times FM$ $\times [1-DSC(K)]/[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operation time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (quantity/item) CST(K) = Unit cost of K^{th} item ($/item) FM = Repair material rate percent of item cost (ratio) DSC(K) = Discard rate of K^{th} item (ratio) R(K) = Mean time between failures of K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)
• Transportation and Packaging •• Material Handling Labor	$\sum_{I=1}^{Y} N(I) \times \sum_{K=1}^{NK} OT \times DC(K)$ $\times QTY(K) \times 2 \times W(K) \times RPL$ $\times [1-RSS(K)] \times [1-DSC(K)]/$ $[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (quantity/item) W(K) = Weight of K^{th} item (lb) RPL = Packaging labor cost ($/lb) RSS(K) = Repair level ratio (ratio) DSC(K) = Discard rate of K^{th} item (ratio) R(K) = Mean time between failure of K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)

(continued)

Table B-1. (continued)		
Cost Element	**Equation**	**Cost Factor Description**
Follow-On Support (continued)		
Transportation and Packaging (continued)		
** Packaging Material	$\sum_{I=1}^{Y} N(I) \times \sum_{K=1}^{NK} OT \times DC(K) \times QTY(K) \times 2 \times W(K) \times RPM \times [1-RSS(K)] \times [1-DSC(K)]/[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (quantity/item) W(K) = Weight of K^{th} item (lb) RPM = Packaging material cost ($/lb) RSS(K) = Repair level ratio (ratio) DSC(K) = Discard rate of K^{th} item (ratio) R(K) = Mean time between failure of K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)
** Shipping	$\sum_{I=1}^{Y} N(I) \times \sum_{K=1}^{NK} OT \times DC(K) \times QTY(K) \times 2 \times W(K) \times RSR \times RW(K) \times [1-RSS(K)] \times [1-DSC(K)]/[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) DC(K) = Duty cycle of K^{th} item (ratio) QTY(K) = Quantity of K^{th} item (lb) W(K) = Weight of K^{th} item (lb) RSR = Shipping cost ($/lb) RW(K) = Item packing weight ratio (shipping weight/unpacked weight) RSS(K) = Repair level ratio (ratio) DSC(K) = Discard rate of K^{th} item (ratio) R(K) = Mean time between failures of K^{th} item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)
Preventive Maintenance		
• Labor	$\sum_{I=1}^{Y} N(I) \times \sum_{N=1}^{NM} OT \times LPM(N) \times RSL/NPM(N)$ where N = Designator for a specific preventive maintenance type NM = Number of preventive maintenance types	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) LPM(N) = Maintenance time of N^{th} type preventive maintenance action (hrs/equipment/action) RSL = O/I maintenance personnel pay rate ($/hr) NPM(N) = Time between inspections of N^{th} preventive maintenance (hrs/action)
• Material	$\sum_{I=1}^{Y} N(I) \times \sum_{N=1}^{NM} OT \times MPM(N)/NPM(N)$	N(I) = Prime equipment inventory (equipment/yr) OT = Prime equipment operating time (hrs/equipment/yr) MPM(N) = Material cost of N^{th} type preventive maintenance action ($/equipment/action) NPM(N) = Time between inspections of N^{th} type preventive maintenance (hrs/action)
Overhaul		
• Labor	$\sum_{I=1}^{Y} \times NOH(I) \times OHL \times RSD$	NOH(I) = Prime equipment overhaul schedule (equipment/yr) OHL = Overhaul maintenance time (hrs/equipment) RSD = Depot maintenance pay rate ($/hr)

(continued)

Table B-1. (continued)

Cost Element	Equation	Cost Factor Description
	Follow-On Support (continued)	
• Material	$\sum_{I=1}^{Y} \times NOH(I) \times OHM$	NOH(I) = Prime equipment overhaul schedule (equipment/yr) OHM = Overhaul maintenance material cost ($/equipment)
• Transportation	$\sum_{I=1}^{Y} NOH(I) \times OHT$	NOH(I) = Prime equipment overhaul schedule (equipment/yr) OHT = Material shipping rate ($/equipment)
Support and Test Equipment Maintenance	$\sum_{I=1}^{Y} N(I) \times STES$	N(I) = Prime equipment inventory (equipment/yr) STES = Recurring support cost of S&TE ($/prime equipment)
Facilities		
• Inventory Storage O/I Level	$\sum_{I=1}^{Y} ISSI(I) \times CSI$	ISSI(I) = O/I maintenance material storage space (sq/ft/yr) CSI = O/I maintenance space cost ($/sq/ft)
• Depot Level	$\sum_{I=1}^{Y} ISSD(I) \times CSD$	ISSD(I) = Depot maintenance material storage space ($/sq/ft) CSD = Depot maintenance space cost ($/sq ft)
Documentation Maintenance	$\sum_{I=1}^{Y} NP \times RDM(I)$	NP = Number of pages in a set of technical data (pages) RDM(I) = Technical data management costs ($/page)
Supply Support		
• Replenishment Spares	$\sum_{I=1}^{Y} N(I) \times \sum_{K=1}^{NK} OT \times DC(K)$ $\times QTY(K) \times CST(K)$ $\times DSC(K)/[R(K) \times FR(I)]$	N(I) = Prime equipment inventory (equipment/yr) *OT = Prime equipment operating time (hrs/equipment/yr)* DC(K) = Duty cycle of Kth item (ratio) QTY(K) = Quantity of Kth item (quantity/item) CST(K) = Unit cost of the Kth item ($/item) DSC(K) = Discard rate of Kth item (ratio) R(K) = Mean time between failures of the Kth item (hrs/failure) FR(I) = Reliability improvement/degradation factor (factor)
• Supply System Management	$\sum_{I=1}^{Y} [(NSNP + NSNS) \times ANM] +$ $\sum_{I=1}^{Y} [(NAP + NAPS) \times AAM]$	NSNP = Number of new NSNs for prime equipment (NSN) NSNS = Number of new NSNs for S&TE equipment (NSN) ANM = Annual NSN maintenance costs ($/NSN) NAP = Number of APLs for prime equipment ($/APL) NAPS = Number of APLs for support and test equipment (APL) AAM = Annual APL maintenance cost ($/APL)
Training		
• Operator	$\sum_{I=1}^{Y} LO(I) \times RAM \times CTO$	LO(I) = Manning level of operating personnel (personnel/yr) RAM = Personnel training costs ($/student) CTO = Operator training costs ($/student)
• O/I Level Maintenance	$\sum_{I=1}^{Y} LM(I) \times RAM \times CTM$	LM(I) = Manning level of O/I maintenance personnel (personnel/yr) RAM = Personnel training costs ($/student) CTM = O/I maintenance personnel training cost ($/student)
• Depot Level Maintenance	$\sum_{I=1}^{Y} LP(I) \times RAP \times CTP$	LP(I) = Manning level of depot maintenance personnel (personnel/yr) RAP = Personnel attrition rate (ratio) CTP = Depot maintenance personnel training cost ($/student)

APPENDIX C

STANDARDIZATION LIFE-CYCLE ELEMENT COSTS, CORRELATION RESULTS

This appendix summarizes the results of correlation exercises for each C/E. The results are presented for each of the SLCC elements, with a comparison of differences derived for standard and nonstandard C/E configurations:

- Table C-1 describes results for a C/E exercised with all models. These results were used to verify that the Enhanced SLCCM's modified sparing procedures did not otherwise affect the original SLCCM results. They also provide a comparison of the results obtained with all three models.
- Table C-2 describes results for two C/Es exercised with the SLCCM and the SSM. These data, for two additional C/Es used in the original SLCCM validation process, were used to compare SSM-derived total SLCC results with Enhanced SLCCM results.

Table C-1. STANDARDIZATION LIFE-CYCLE ELEMENT COSTS FOR ONE C/E -- ALL MODELS (THOUSANDS OF DOLLARS)

Component/Equipment: Lube Oil Filter -- APL 487140001

Element	Standard			Nonstandard			Difference (Standard vs. Nonstandard		
	SLCCM	Enhanced SLCCM	SSM	SLCCM	Enhanced SLCCM	SSM	SLCCM	Enhanced SLCCM	SSM
Government Program Management	*	*		1	1		1	1	
Prime Equipment Acquisition									
Production Hardware	979	979	979	884	884	884	(95)**	(95)	(95)
Production Support and Services	*	*		*	*		0	0	
Production Test and Equipment	7	7		78	78		71	71	
Initial Support Acquisition									
Support and Test Equipment Acquisition	5	20		62	78		57	58	
Documentation	50	50		50	50		0	0	
Training	165	165	165	171	171	171	6	6	6
Follow-On Support									
Corrective Maintenance	52	52		53	53		1	1	
Preventive Maintenance	78	78	78	93	93	93	15	15	15
Overhaul	150	150	150	241	241	241	91	91	91
Support and Test Equipment Maintenance	*	*		*	*		0	0	
Facilities	1	1		1	1		0	0	
Document Maintenance	23	23		23	23		0	0	
Supply Support	7	7		11	11		4	4	
Training	224	224	224	224	224	224	0	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

Table C-2. STANDARDIZATION LIFE-CYCLE ELEMENT COSTS FOR TWO C/Es, SLCCM -- SSM CORRELATION (THOUSANDS OF DOLLARS)

Component/Equipment: Compressor, L.P. Air -- APL 061430250C

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		2		2	0
Prime Equipment Acquisition						
Production Hardware	2,568	2,568	2,315	2,315	(253)**	(253)
Production Support and Services	*		*		0	
Production Test and Equipment	10		115		105	
Initial Support Acquisition						
Support and Test Equipment Acquisition	32		182		150	
Documentation	71		71		0	
Training	1,455	1,455	1,524	1,524	69	69
Follow-On Support						
Corrective Maintenance	242		247		5	
Preventive Maintenance	1,429	1,429	1,685	1,685	257	257
Overhaul	2,223	2,223	3,712	3,712	1,489	1,489
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	28		28		0	
Supply Support	49		58		9	
Training	953	953	953	953	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table C-2. (continued)

Component/Equipment: Refrigeration Plant, Air Cond. -- APL 325010399

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	4,896	4,896	4,409	4,409	(487)**	(487)
Production Support and Services	*		*		0	
Production Test and Equipment	3		48		48	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		279		278	
Documentation	93		93		0	
Training	978	978	1,005	1,005	27	27
Follow-On Support						
Corrective Maintenance	3		3		0	
Preventive Maintenance	1,497	1,497	1,780	1,780	283	283
Overhaul	1,289	1,289	2,289	2,289	1,000	1,000
Support and Test Equipment Maintenance	*		*		0	
Facilities	16		16		0	
Document Maintenance	45		45		0	
Supply Support	1		4		3	
Training	571	571	571	571	0	0

* = Less than $500. **( ) = Nonstandard is Less than Standard.

APPENDIX D

SAMPLE ENHANCED SLCCM AND SSM PROGRAM RUNS

This appendix provides a set of four program runs for one C/E. One run was made for the standard C/E with both the Enhanced SLCCM and the SSM. Similar runs were completed for the same C/E modified to be a nonstandard configuration. Each run is labeled to identify the employed standardization model; the label shows whether that run is for the standard or nonstandard configuration. The sample C/E is the Unit Heater, Air--APL 070970004.

The main portions of these printouts are identified by circled numbers, as follows:

1. The C/E data file calls and the RUN command to begin program execution.

2. Data entries made during program operation. Since basic data files contained data for standard C/Es, this printout portion appears only in nonstandard C/E runs where data changes were made to simulate nonstandard C/Es.

3. A detailed year-by-year printout of the generated standardization life-cycle cost. The columns in this listing are as follows:

   - YEAR - life-cycle year
   - PEA - Prime Equipment Acquisition costs
   - PMG - Government Program Management costs
   - ISA - Initial Support Acquisition costs
   - SUP - Support costs
   - LCC - Life-Cycle cost

4. A listing of all single-valued variable data used to calculate the standardization life-cycle cost.

5. A listing of all year-indexed variable data used to calculate the standardization life-cycle cost.

(6) A listing of the input data items to which the computed SLCC is most sensitive. The columns contain the following:

1st Column - the program name for the input data item

2nd Column - the computed SLCC PEA value, with the data item varied by the percentage requested during program execution

3rd Column - the computed SLCC PMG value, with the data item varied by the percentage requested during program execution

4th Column - the computed SLCC ISA value, with the data item varied by the percentage requested during program execution

5th Column - the computed SLCC SUP value, with the data item varied by the percentage requested during the program execution

6th Column - the computed SLCC LCC value, with the data item varied by the percentage requested during program execution

7th Column - indication of whether the data item variation was above (HI) or below (LOW) the base value entered as SLCC data

8th Column - the percentage of the change in SLCC due to the requested percentage change in data element value

(7) A listing of the C/E part data used in computing the standardization life-cycle cost. Data for each part are contained on the three lines beginning with the same part number.

(8) The LCC element subtotal costs that have gone into the computed standardization LCC. The columns contain the following:

1st Column - the program variable name for the element subtotals

2nd Column - the element subtotals for the last year of the life cycle

3rd Column - the element subtotal for the entire life cycle

4th Column - the element percentage of the total life-cycle-cost

```
OLD,LCCX
READY.
GET,TAPE1=070971
READY.
GET,TAPE2=VARNAM
READY.
GET,TAPE3=070973
READY.
GET,TAPE4=070974
READY.
GET,TAPE5=070975
READY.
FTNTS
READY.
SBULIM,JS=900
READY.
RUN,MA=77777
```

1

ENHANCED SLCCM

STANDARD C/E

```
 80/01 09. 10.11.59.
PROGRAM   LCCX

END OF SINGLE VARIABLE INITIALIZATION.
ENTER NEW VARIABLES & VALUES OR SPACE, THEN RETURN.
? SPARE=0.0
? SEM  =0.0
?
```

YEAR	PEA	PMG	ISA	SUP	LCC
1	21165.	157.	6441.	2617.	30379.
2	23373.	0.	1110.	5552.	30035.
3	24654.	0.	1170.	8640.	34465.
4	26019.	0.	1235.	12057.	39312.
5	27447.	0.	1303.	20137.	48887.
6	28959.	0.	1375.	24517.	54851.
7	30555.	0.	1451.	29319.	61325.
8	32235.	0.	1530.	34572.	68337.
9	33999.	0.	1614.	4565[illegible].	81265.
10	35868.	0.	1703.	52217.	89787.
11	37842.	0.	1797.	59360.	98999.
12	39921.	0.	1895.	67130.	108946.
TOTAL	362037.	157.	22624.	361765.	746563.

3

```
SUBTOTAL GROUP NO.    1 DUMPED TO TAPE7.
DO YOU WANT SUBTOTALS PRINTED HERE? NO


DO YOU WANT VARIANCES CALCULATED? YES
 WHAT IS VARIANCE PERCENTAGE? 25.
 WHAT IS MINIMUM % LCC CHANGE OF CONCERN? 1.
```

```
VARIANCES BEING CALCULATED...
VARIANCE GROUP NO.  1:  CHANGE=  .2500 LIMIT=  .0100
        38 VARIANCES HIGHER THAN LIMIT WRITTEN TO TAPE6.
WOULD YOU LIKE TO CHANGE VARIABLE VALUES AND CALCULATE ANOTHER LCC? NO

WOULD YOU LIKE DATA LISTINGS? YES                      4

 SINGLE VALUE DATA? YES
 AAM  =       11.00  ◆  HRG   =        1.00  ◆  NSNP =     0.00
 ACDP =        2.00  ◆        =        0.00  ◆  NSNS =     0.00
 ACP  =        7.00  ◆  HRH   =        1.00  ◆  OHL  =     4.00
 AHA  =       27.50  ◆  HRI   =        1.00  ◆       =     0.00
 ANM  =      225.00  ◆  HRJ   =        1.00  ◆  OHM  =   200.00
      =        0.00  ◆  HRK   =        1.00  ◆  OHT  =     7.75
 CACD =     1250.00  ◆  HRM   =        0.00  ◆  OT   =  2000.00
 CACP =      338.00  ◆        =        0.00  ◆  PAPL =     3.00
 CEOB =       10.00  ◆  HRN   =       22.56  ◆  POPOB=     0.00
 CHCD =     2500.00  ◆  HRT   =        3.00  ◆       =     0.00
 CHCP =      367.00  ◆  K     =        4.00  ◆  PHS  =    22.56
      =        0.00  ◆  LBB   =       26.88  ◆  PHT  =     0.00
 CNP  =      455.00  ◆  LBC   =       26.88  ◆  POPZ =   120.00
 CP   =         .06  ◆        =        0.00  ◆  PPC  =   169.00
 CPL  =       13.34  ◆  LBE   =       26.88  ◆  PTC  =   100.00
 CSD  =        3.47  ◆  N     =        2.00  ◆       =     0.00
 CSI  =       43.66  ◆  NAP   =        1.00  ◆  RAM  =      .45
      =        0.00  ◆  NAPL  =        4.00  ◆  RAP  =      .14
 CTI  =       21.84  ◆  NAPS  =        0.00  ◆  RDM  =    18.60
 CTM  =       21.84  ◆        =        0.00  ◆  RPL  =     1.80
 CTO  =       21.84  ◆  NHB   =        1.00  ◆  RPM  =     1.79
 CTP  =       21.34  ◆  NHC   =        1.00  ◆  RSD  =    30.66
 CU   =     2000.00  ◆  NHF   =        0.00  ◆  RSL  =     9.94
      =        0.00  ◆  NHH   =        1.00  ◆  RSR  =      .50
 FM   =         .11  ◆  NK    =        4.00  ◆  SHIPS=    12.00
 FPST =      902.00  ◆        =        0.00  ◆  STEM =      .26
 HCDP =        0.00  ◆  NM    =        2.00  ◆  STES =      .12
 HCP  =        1.00  ◆  NP    =       10.00  ◆  Y    =    12.00
```

YEAR DATA? YES

YEAR	ATU	FR	ISSD	ISSI	LM	LD
1	140.00	1.00	1.20	1.00	100.00	60.00
2	0.00	1.00	1.20	1.00	200.00	120.00
3	0.00	1.00	1.20	1.00	300.00	180.00
4	0.00	1.00	1.20	1.00	400.00	240.00
5	0.00	1.00	1.20	1.00	500.00	300.00
6	0.00	1.00	1.20	1.00	600.00	360.00
7	0.00	1.00	1.20	1.00	700.00	420.00
8	0.00	1.00	1.20	1.00	800.00	480.00
9	0.00	1.00	1.20	1.00	900.00	540.00
10	0.00	1.00	1.20	1.00	1000.00	600.00
11	0.00	1.00	1.20	1.00	1100.00	660.00
12	0.00	1.00	1.20	1.00	1200.00	720.00
YEAR	LP	NC	N	NN	NOH	PSS
1	120.00	24.00	10.00	10.00	0.00	0.00
2	240.00	0.00	20.00	10.00	0.00	0.00
3	360.00	0.00	30.00	10.00	0.00	0.00
4	480.00	0.00	40.00	10.00	0.00	0.00
5	600.00	0.00	50.00	10.00	10.00	0.00
6	720.00	0.00	60.00	10.00	10.00	0.00
7	840.00	0.00	70.00	10.00	10.00	0.00
8	960.00	0.00	80.00	10.00	10.00	0.00
9	1080.00	0.00	90.00	10.00	20.00	0.00
10	1200.00	0.00	100.00	10.00	20.00	0.00
11	1320.00	0.00	110.00	10.00	20.00	0.00
12	1440.00	0.00	120.00	10.00	20.00	0.00
YEAR	PTI	PTM	PTD	PTP	STE	INF
1	2.00	20.00	2.00	20.00	0.00	1.00
2	2.00	20.00	2.00	20.00	0.00	1.11
3	2.00	20.00	2.00	20.00	0.00	1.17
4	2.00	20.00	2.00	20.00	0.00	1.24
5	2.00	20.00	2.00	20.00	0.00	1.31
6	2.00	20.00	2.00	20.00	0.00	1.38
7	2.00	20.00	2.00	20.00	0.00	1.46
8	2.00	20.00	2.00	20.00	0.00	1.54
9	2.00	20.00	2.00	20.00	0.00	1.62
10	2.00	20.00	2.00	20.00	0.00	1.71
11	2.00	20.00	2.00	20.00	0.00	1.80
12	2.00	20.00	2.00	20.00	0.00	1.90
YEAR	TDP	PET				
1	0.00	10.00				
2	0.00	10.00				
3	0.00	10.00				
4	0.00	10.00				
5	0.00	10.00				
6	0.00	10.00				
7	0.00	10.00				
8	0.00	10.00				
9	0.00	10.00				
10	0.00	10.00				
11	0.00	10.00				
12	0.00	10.00				

5

VARIANCE GROUP NO. 1: CHANGE= .2500 LIMIT= .0100

6

YEAR	PEA	PMG	ISA	SUP	LCC			
INF	385162.	2851.	1479399.	1184533.	3051945.	HI	25.00	1
INF	231097.	1710.	887640.	710720.	1831167.	LOW	25.00	1
NPM	308130.	2280.	1183520.	1128995.	2622925.	LOW	7.43	1
OT	308130.	2280.	1183529.	1083752.	2577691.	HI	5.58	1
OT	308130.	2280.	1183510.	811502.	2305422.	LOW	5.58	1
N	308130.	2280.	1183520.	1083757.	2577687.	HI	5.58	1
N	308130.	2280.	1183520.	811496.	2305426.	LOW	5.58	1
CTM	308130.	2280.	1302069.	964655.	2577134.	HI	5.55	1
CTM	3081[illegible].	2280.	1064970.	930598.	2305978.	LOW	5.55	1
PTM	308130.	2280.	1302069.	947627.	2560106.	HI	4.86	1
PTM	308130.	2280.	1064970.	947627.	2323007.	LOW	4.86	1
MPM	308130.	2280.	1183520.	1062663.	2556593.	HI	4.71	1
MPM	308130.	2280.	1183520.	832590.	2326520.	LOW	4.71	1
NPM	308130.	2280.	1183520.	838805.	2332735.	HI	4.46	1
CTI	308130.	2280.	1262552.	947627.	2520589.	HI	3.24	1
CTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
PTI	308130.	2280.	1262552.	947627.	2520589.	HI	3.24	1
PTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
CTP	308130.	2280.	1242794.	952887.	2506091.	HI	2.64	1
CTP	308130.	2280.	1124245.	942367.	2377022.	LOW	2.64	1
CU	369792.	2280.	1183520.	947627.	2503219.	HI	2.53	1
CU	246467.	2280.	1183520.	947627.	2379894.	LOW	2.53	1
NN	369792.	2280.	1183529.	947627.	2503229.	HI	2.53	1
NN	246467.	2280.	1183510.	947627.	2379884.	LOW	2.53	1
PTP	308130.	2280.	1242794.	947627.	2500831.	HI	2.43	1
PTP	308130.	2280.	1124245.	947627.	2382282.	LOW	2.43	1
NOH	308130.	2280.	1183520.	1003395.	2497325.	HI	2.28	1
NOH	308130.	2280.	1183520.	891858.	2385788.	LOW	2.28	1
OHM	308130.	2280.	1183520.	988607.	2482536.	HI	1.68	1
OHM	308130.	2280.	1183520.	906646.	2400576.	LOW	1.68	1
CTO	308130.	2280.	1203278.	964655.	2478343.	HI	1.51	1
CTO	308130.	2280.	1163761.	930598.	2404770.	LOW	1.51	1
RAM	308130.	2280.	1183520.	981684.	2475613.	HI	1.39	1
RAM	308130.	2280.	1183520.	913569.	2407499.	LOW	1.39	1

READY.

PART DATA? YES

7

PART	CST	DC	DSC	QTY	R	RSS	RW
1	1200.00	1.0000	.5000	1.	83000.	.9900	1.2000
2	2.71	1.0000	1.0000	1.	5200.	.9900	1.2000
3	690.15	1.0000	.9000	1.	99999999.	.9900	1.2000
4	36.36	1.0000	.9000	1.	27000.	.9900	1.2000

PART	W	LCD	LSD	LSI	RF	COG	PLT
1	500.00	8.00	0.00	0.00	.0104	9C	9.00
2	.50	.50	0.00	0.00	.0638	9G	9.00
3	50.00	4.00	0.00	0.00	.0135	9G	9.00
4	50.00	4.00	0.00	0.00	.0390	9G	9.00

PART	SL	TOR	MRU	PSC	PMR	WSAVL	OBSA
1	36.	◆◆	.75	PA@@	1.	0.0000	0.0000
2	36.	◆◆	.75	PF@@	1.	0.0000	.7500
3	36.	◆◆	.75	PF@@	1.	0.0000	0.0000
4	36.	◆◆	.75	PB@@	1.	0.0000	.7500

```
OLD,B77
READY.
LNH                                                   8
          SUBTOTAL  GROUP NUMBER     1
PMGG            0.          27.            .0036        1
PMGH            0.          27.            .0036        1
PMGI            0.          27.            .0036        1
PMGJ            0.          27.            .0036        1
PMGK            0.          27.            .0036        1
PMGL            0.          23.            .0030        1
PMGM            0.           0.           0.0000        1
TCU         38020.      344640.          46.1623        1
TPHB            0.          28.            .0037        1
TPHC            0.          28.            .0037        1
TPHF            0.           0.           0.0000        1
TPHH            0.          28.            .0037        1
TPHR            0.           0.           0.0000        1
TPSS            0.           0.           0.0000        1
EPT          1901.       17232.           2.3081        1
TD              0.           0.           0.0000        1
RTD             0.          83.            .0111        1
TSTE            0.           0.           0.0000        1
SPE            69.         621.            .0832        1
SSTE            0.           0.           0.0000        1
APLE            0.          56.            .0075        1
NSNE            0.           0.           0.0000        1
AD              0.        5233.            .7009        1
TNC             0.          14.            .0019        1
TPTO           83.         753.            .1008        1
TPTM          830.        7527.           1.0082        1
TPTP          830.        7527.           1.0082        1
TPTI           83.         753.            .1008        1
TATU            0.         140.            .0188        1
CMRR         1545.        8349.           1.1184        1
CMOI            0.           0.           0.0000        1
CMD             0.           0.           0.0000        1
CMRM          363.        1961.            .2626        1
TPMH           53.         284.            .0380        1
TPPM           52.         282.            .0378        1
TPSH            0.           0.           0.0000        1
PML          2100.       11345.           1.5196        1
PMM          1690.        9131.           1.2230        1
NOHL         4663.       24204.           3.2420        1
NOHM         7604.       39472.           5.2870        1
NOHT          295.        1530.            .2049        1
STM            27.         148.            .0198        1
TISSI          83.         752.            .1008        1
TISSD           8.          72.            .0096        1
DM            354.        3205.            .4293        1
SSRS         4092.       22109.           2.9614        1
SSM            21.         190.            .0254        1
LO          13452.       72686.           9.7358        1
LM          22420.      121143.          16.2263        1
LP           8310.       44904.           6.0145        1
READY.
```

```
OLD,LCCX
READY.
GET,TAPE1=070971
READY.
GET,TAPE2=VARNAM
READY.
GET,TAPE3=070973
READY.
GET,TAPE4=070974
READY.
GET,TAPE5=070975
READY.
FTNTS
READY.
SBULIM,JS=900
READY.
RUN,MA=77777

 80/01/09. 10.45.50.
PROGRAM   LCCX

END OF SINGLE VARIABLE INITIALIZATION.
ENTER NEW VARIABLES & VALUES OF SPACE, THEN RETURN.
? SPARE=0.0
? SEM  =0.0
? CU   =1800.
? HRG  =10.
? HRH  =2.
? HRI  =2.
? HRJ  =2.
? HRK  =4.
? HRM  =14.
? HRT  =30.
? NHB  =2.
? NHC  =1.5
? NHF  =10.
? NSNP  =1.
   NSNP  = < ERROR, RETYPE RECORD AT THIS FIELD
? NSNP =1.
        N < ERROR, RETYPE RECORD AT THIS FIELD
?
? NSNP =1.
? OHL  =4.2
? OHM  =360.
? PHT  =1.
? POPZ =0.
? PTC  =400.
? MAT
```

ENHANCED SLCCM

NONSTANDARD C/E

1

2

```
***MATRIX DATA ENTRY MODE***

...VALUE ENTRIES REQUIRED...

MATRIX NAME ? STE
    INDEX? 1.
    VALUE? 10800.

MATRIX NAME ? TDP
    INDEX? 1.
    VALUE? 4.

MATRIX NAME ? ATU
    INDEX? 1.
    VALUE? 1800.

MATRIX NAME ? P-ON

%%%PERCENTAGE ENTRIES REQUIRED%%%

MATRIX NAME ? PTI
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? PTM
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? PTO
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? PTP
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? CST
    INDEX? 0.
    VALUE? 10.

MATRIX NAME ? LPM
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? MPM
    INDEX? 0.
    VALUE? 10.

MATRIX NAME ? NPM
    INDEX? 0.
    VALUE? -10.
```

2

```
MATRIX NAME ? SINGL
ENTER NEW VARIABLES & VALUES OR SPACE, THEN RETURN.
?
 YEAR       PEA        PMG       ISA       SUP          LCC
 ----       ---        ---       ---       ---          ---
    1     23922.      936.    22219.     2893.       49970.
    2     24486.        0.     1171.     5917.       31573.
    3     25828.        0.     1235.     9085.       36148.
    4     27258.        0.     1303.    12591.       41152.
    5     28754.        0.     1375.    22938.       53067.
    6     30338.        0.     1451.    27543.       59332.   3
    7     32010.        0.     1531.    32586.       66127.
    8     33770.        0.     1615.    38097.       73482.
    9     35618.        0.     1703.    52144.       89465.
   10     37576.        0.     1797.    59149.       98521.
   11     39644.        0.     1896.    66770.      108310.
   12     41822.        0.     2000.    75045.      118866.
      ---------------------------------------------------------
TOTAL    381026.      936.    39295.   404757.      826014.


SUBTOTAL GROUP NO.    1 DUMPED TO TAPE7.
DO YOU WANT SUBTOTALS PRINTED HERE? NO


DO YOU WANT VARIANCES CALCULATED? YES
 WHAT IS VARIANCE PERCENTAGE? 25.
 WHAT IS MINIMUM % LCC CHANGE OF CONCERN? 1.


VARIANCES BEING CALCULATED...
VARIANCE GROUP NO.  1:  CHANGE=  .2500 LIMIT=  .0100
        42 VARIANCES HIGHER THAN LIMIT WRITTEN TO TAPE6.
WOULD YOU LIKE TO CHANGE VARIABLE VALUES AND CALCULATE ANOTHER LCC? NO
```

WOULD YOU LIKE DATA LISTINGS? YES

4

SINGLE VALUE DATA? YES

AAM =	11.00	HRG =	10.00	NSNP =	1.00
ACDP =	2.00	=	0.00	NSNS =	0.00
ACP =	7.00	HRH =	2.00	DHL =	4.20
AHA =	27.50	HRI =	2.00	=	0.00
ANM =	225.00	HRJ =	2.00	DHM =	360.00
=	0.00	HRK =	4.00	DHT =	7.75
CACD =	1250.00	HRM =	14.00	DT =	2000.00
CACP =	338.00	=	0.00	PAPL =	3.00
CEDB =	10.00	HRN =	22.56	PDFDB=	0.00
CHCD =	2500.00	HRT =	30.00	=	0.00
CHCP =	367.00	K =	4.00	PHS =	22.56
=	0.00	LBB =	26.88	PHT =	1.00
CNP =	455.00	LBC =	26.88	PDFZ =	0.00
CP =	.06	=	0.00	PPC =	169.00
CPL =	13.34	LBE =	26.88	PTC =	400.00
CSD =	3.47	N =	2.00	=	0.00
CSI =	43.66	NAP =	1.00	RAM =	.45
=	0.00	NAPL =	4.00	RAP =	.14
CTI =	21.84	NAPS =	0.00	RDM =	18.60
CTM =	21.84	=	0.00	RPL =	1.80
CTD =	21.84	NHB =	2.00	RPM =	1.79
CTP =	21.84	NHC =	1.50	RSD =	30.66
CU =	1800.00	NHF =	10.00	RSL =	9.94
=	0.00	NHH =	1.00	RSR =	.50
FM =	.11	NK =	4.00	SHIPS=	12.00
FPST =	802.00	=	0.00	STEM =	.26
HCDP =	0.00	NM =	2.00	STES =	.12
HCP =	1.00	NP =	10.00	Y =	12.00

YEAR DATA? YES

YEAR	ATU	FR	ISSD	ISSI	LM	LD
1	1800.00	1.00	1.20	1.00	100.00	60.00
2	0.00	1.00	1.20	1.00	200.00	120.00
3	0.00	1.00	1.20	1.00	300.00	180.00
4	0.00	1.00	1.20	1.00	400.00	240.00
5	0.00	1.00	1.20	1.00	500.00	300.00
6	0.00	1.00	1.20	1.00	600.00	360.00
7	0.00	1.00	1.20	1.00	700.00	420.00
8	0.00	1.00	1.20	1.00	800.00	480.00
9	0.00	1.00	1.20	1.00	900.00	540.00
10	0.00	1.00	1.20	1.00	1000.00	600.00
11	0.00	1.00	1.20	1.00	1100.00	660.00
12	0.00	1.00	1.20	1.00	1200.00	720.00

YEAR	LP	NC	N	NN	NDH	PSS
1	120.00	24.00	10.00	10.00	0.00	0.00
2	240.00	0.00	20.00	10.00	0.00	0.00
3	360.00	0.00	30.00	10.00	0.00	0.00
4	480.00	0.00	40.00	10.00	0.00	0.00
5	600.00	0.00	50.00	10.00	10.00	0.00
6	720.00	0.00	60.00	10.00	10.00	0.00
7	840.00	0.00	70.00	10.00	10.00	0.00
8	960.00	0.00	80.00	10.00	10.00	0.00
9	1080.00	0.00	90.00	10.00	20.00	0.00
10	1200.00	0.00	100.00	10.00	20.00	0.00
11	1320.00	0.00	110.00	10.00	20.00	0.00
12	1440.00	0.00	120.00	10.00	20.00	0.00

YEAR	PTI	PTM	PTD	PTP	STE	INF
1	2.10	21.00	2.10	21.00	10800.00	1.00
2	2.10	21.00	2.10	21.00	0.00	1.11
3	2.10	21.00	2.10	21.00	0.00	1.17
4	2.10	21.00	2.10	21.00	0.00	1.24
5	2.10	21.00	2.10	21.00	0.00	1.31
6	2.10	21.00	2.10	21.00	0.00	1.38
7	2.10	21.00	2.10	21.00	0.00	1.46
8	2.10	21.00	2.10	21.00	0.00	1.54
9	2.10	21.00	2.10	21.00	0.00	1.62
10	2.10	21.00	2.10	21.00	0.00	1.71
11	2.10	21.00	2.10	21.00	0.00	1.80
12	2.10	21.00	2.10	21.00	0.00	1.90

YEAR	TDP	PET
1	4.00	10.00
2	0.00	10.00
3	0.00	10.00
4	0.00	10.00
5	0.00	10.00
6	0.00	10.00
7	0.00	10.00
8	0.00	10.00
9	0.00	10.00
10	0.00	10.00
11	0.00	10.00
12	0.00	10.00

5

VARIANCE GROUP NO. 1: CHANGE= .2500 LIMIT= .0100

6

YEAR	PEA	PMG	ISA	SUP	LCC			
----	---	---	---	---	---			
INF	385162.	2851.	1479399.	1184533.	3051945.	HI	25.00	1
INF	231097.	1710.	887640.	710720.	1831167.	LOW	25.00	1
NPM	308130.	2280.	1183520.	1128995.	2622925.	LOW	7.43	1
OT	308130.	2280.	1183529.	1083752.	2577691.	HI	5.58	1
OT	308130.	2280.	1183510.	811502.	2305422.	LOW	5.58	1
N	308130.	2280.	1183520.	1083757.	2577687.	HI	5.58	1
N	308130.	2280.	1183520.	811496.	2305426.	LOW	5.58	1
CTM	308130.	2280.	1302069.	964655.	2577134.	HI	5.55	1
CTM	308130.	2280.	1064970.	930598.	2305978.	LOW	5.55	1
PTM	308130.	2280.	1302069.	947627.	2560106.	HI	4.86	1
PTM	308130.	2280.	1064970.	947627.	2323007.	LOW	4.86	1
MPM	308130.	2280.	1183520.	1062663.	2556593.	HI	4.71	1
MPM	308130.	2280.	1183520.	832590.	2326520.	LOW	4.71	1
NPM	308130.	2280.	1183520.	838805.	2332735.	HI	4.46	1
CTI	308130.	2280.	1262552.	947627.	2520589.	HI	3.24	1
CTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
PTI	308130.	2280.	1262552.	947627.	2520599.	HI	3.24	1
PTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
CTP	308130.	2280.	1242794.	952887.	2506091.	HI	2.64	1
CTP	308130.	2280.	1124245.	942367.	2377022.	LOW	2.64	1
CU	369792.	2280.	1183520.	947627.	2503219.	HI	2.53	1
CU	246467.	2280.	1183520.	947627.	2379894.	LOW	2.53	1
NN	369792.	2280.	1183529.	947627.	2503229.	HI	2.53	1
NN	246467.	2280.	1183510.	947627.	2379884.	LOW	2.53	1
PTP	308130.	2280.	1242794.	947627.	2500831.	HI	2.43	1
PTP	308130.	2280.	1124245.	947627.	2382282.	LOW	2.43	1
NOH	308130.	2280.	1183520.	1003395.	2497325.	HI	2.28	1
NOH	308130.	2280.	1183520.	891858.	2385788.	LOW	2.28	1
OHM	308130.	2280.	1183520.	988607.	2482536.	HI	1.68	1
OHM	308130.	2280.	1183520.	906646.	2400576.	LOW	1.68	1
CTO	308130.	2280.	1203278.	964655.	2478343.	HI	1.51	1
CTO	308130.	2280.	1163761.	930598.	2404770.	LOW	1.51	1
RAM	308130.	2280.	1183520.	981684.	2475613.	HI	1.39	1
RAM	308130.	2280.	1183520.	913569.	2407499.	LOW	1.39	1

READY.

PART DATA? YES

7

PART	CST	DC	DSC	QTY	R	RSS	RW
1	1320.00	1.0000	.5000	1.	83000.	.9900	1.2000
2	2.98	1.0000	1.0000	1.	5200.	.9900	1.2000
3	759.17	1.0000	.5000	1.	99999999.	.9900	1.2000
4	40.00	1.0000	.9000	1.	27000.	.9900	1.2000

PART	W	LSD	LSD	LSI	RF	COG	PLT
1	500.00	8.00	0.00	0.00	.0104	9C	9.00
2	.50	.50	0.00	0.00	.0638	9G	9.00
3	50.00	4.00	0.00	0.00	.0135	9G	9.00
4	50.00	4.00	0.00	0.00	.0390	9G	9.00

PART	SL	TOP	MPU	PSC	PMP	WSAVL	DRSA
1	36.	◆◆	.75	PA@@	1.	0.0000	0.0000
2	36.	◆◆	.75	PF@@	1.	0.0000	.7500
3	36.	◆◆	.75	PF@@	1.	0.0000	0.0000
4	36.	◆◆	.75	PB@@	1.	0.0000	.7500

```
OLD,B7
READY.
LNH                                              8
              SUBTOTAL GROUP NUMBER    1
```

PMGG	0.	269.	.0325	1
PMGH	0.	54.	.0065	1
PMGI	0.	54.	.0065	1
PMGJ	0.	54.	.0065	1
PMGK	0.	108.	.0130	1
PMGL	0.	23.	.0027	1
PMGM	0.	376.	.0456	1
TCU	34218.	310176.	37.5509	1
TPHB	0.	55.	.0067	1
TPHC	0.	41.	.0050	1
TPHF	0.	275.	.0333	1
TPHH	0.	28.	.0033	1
TPHR	0.	23.	.0027	1
TPSS	0.	0.	0.0000	1
EPT	7604.	68928.	8.3446	1
TD	0.	676.	.0818	1
RTD	0.	825.	.0999	1
TSTE	0.	10800.	1.3075	1
SPE	82.	741.	.0897	1
SSTE	0.	2808.	.3399	1
APLE	0.	56.	.0068	1
NSNE	0.	455.	.0551	1
AD	0.	5233.	.6335	1
TNC	0.	14.	.0017	1
TPTD	87.	790.	.0957	1
TPTM	872.	7903.	.9568	1
TPTP	872.	7903.	.9568	1
TPTI	87.	790.	.0957	1
TATU	0.	1800.	.2179	1
CMPR	1545.	8349.	1.0108	1
CMDI	0.	0.	0.0000	1
CMD	0.	0.	0.0000	1
CMRM	399.	2157.	.2611	1
TPMH	53.	284.	.0344	1
TPPM	52.	282.	.0342	1
TPSH	0.	0.	0.0000	1
PML	2449.	13236.	1.6023	1
PMM	2065.	11160.	1.3510	1
NDHL	4896.	25414.	3.0768	1
NDHM	13687.	71050.	8.6015	1
NDHT	295.	1530.	.1852	1
STM	27.	148.	.0179	1
TISSI	83.	752.	.0911	1
TISSD	8.	72.	.0087	1
DM	354.	3205.	.3880	1
SSRS	4501.	24320.	2.9443	1
SSM	449.	4067.	.4923	1
LD	13452.	72686.	8.7996	1
LM	22420.	121143.	14.6660	1
LP	8310.	44904.	5.4362	1

READY.

```
OLD,LCCX
READY.
GET,TAPE1=070971
READY.
GET,TAPE2=VARNAM
READY.
GET,TAPE3=070973
READY.
GET,TAPE4=070974
READY.
GET,TAPE5=070975
READY.
FTNTS
READY.
SBULIM,JS=900    1
READY.
RUN,MA=77777

 80/01/09. 10.31.51.
PROGRAM   LCCX

END OF SINGLE VARIABLE INITIALIZATION.
ENTER NEW VARIABLES & VALUES OR SPACE, THEN RETURN.
? SEM  =1.0
?
```

SSM

STANDARD C/E

YEAR	PEA	PMG	ISA	SUP	LCC
----	---	---	---	---	---
1	20083.	0.	1101.	2103.	23286.
2	22260.	0.	1070.	4681.	28011.
3	23480.	0.	1128.	7406.	32015.
4	24780.	0.	1191.	10422.	36393.
5	26140.	0.	1256.	18061.	45457.
6	27580.	0.	1325.	21955.	50860.
7	29100.	0.	1398.	26225.	56723. 3
8	30700.	0.	1475.	30895.	63070.
9	32380.	0.	1556.	41339.	75275.
10	34160.	0.	1641.	47203.	83005.
11	36040.	0.	1732.	53591.	91362.
12	38020.	0.	1827.	60532.	100379.
TOTAL	344723.	0.	16699.	324413.	685835.

```
SUBTOTAL GROUP NO.    1 DUMPED TO TAPE7.
DO YOU WANT SUBTOTALS PRINTED HERE? NO


DO YOU WANT VARIANCES CALCULATED? YES
 WHAT IS VARIANCE PERCENTAGE? 25.
 WHAT IS MINIMUM % LCC CHANGE OF CONCERN? 1.
```

VARIANCES BEING CALCULATED...
VARIANCE GROUP NO. 1: CHANGE= .2500 LIMIT= .0100
26 VARIANCES HIGHER THAN LIMIT WRITTEN TO TAPE6.
WOULD YOU LIKE TO CHANGE VARIABLE VALUES AND CALCULATE ANOTHER LCC? NO

WOULD YOU LIKE DATA LISTINGS? YES

4

SINGLE VALUE DATA? YES

AAM =	11.00	HRG =	1.00	NSNP =	0.00
ACDP =	2.00	=	0.00	NSNS =	0.00
ACP =	7.00	HRH =	1.00	OHL =	4.00
AHA =	27.50	HRI =	1.00	=	0.00
ANM =	225.00	HRJ =	1.00	OHM =	200.00
=	0.00	HRK =	1.00	OHT =	7.75
CACD =	1250.00	HRM =	0.00	OT =	2000.00
CACP =	338.00	=	0.00	PAPL =	3.00
CEOB =	10.00	HRN =	22.56	POPOB=	0.00
CHCD =	2500.00	HRT =	3.00	=	0.00
CHCP =	367.00	K =	4.00	PHS =	22.56
=	0.00	LBB =	26.88	PHT =	0.00
CNP =	455.00	LBC =	26.88	POPZ =	120.00
CP =	.06	=	0.00	PPC =	169.00
CPL =	13.34	LBE =	26.88	PTC =	100.00
CSD =	3.47	N =	2.00	=	0.00
CSI =	43.66	NAP =	1.00	RAM =	.45
=	0.00	NAPL =	4.00	RAP =	.14
CTI =	21.84	NAPS =	0.00	RDM =	18.60
CTM =	21.84	=	0.00	RPL =	1.80
CTO =	21.84	NHB =	1.00	RPM =	1.79
CTP =	21.84	NHC =	1.00	RSD =	30.66
CU =	2000.00	NHF =	0.00	RSL =	9.94
=	0.00	NHH =	1.00	RSR =	.50
FM =	.11	NK =	4.00	SHIPS=	12.00
FPST =	802.00	=	0.00	STEM =	.26
HCDP =	0.00	NM =	2.00	STES =	.12
HCP =	1.00	NP =	10.00	Y =	12.00

YEAR DATA? YES

YEAR	ATU	FR	ISSD	ISSI	LM	LD
1	140.00	1.00	1.20	1.00	100.00	60.00
2	0.00	1.00	1.20	1.00	200.00	120.00
3	0.00	1.00	1.20	1.00	300.00	180.00
4	0.00	1.00	1.20	1.00	400.00	240.00
5	0.00	1.00	1.20	1.00	500.00	300.00
6	0.00	1.00	1.20	1.00	600.00	360.00
7	0.00	1.00	1.20	1.00	700.00	420.00
8	0.00	1.00	1.20	1.00	800.00	480.00
9	0.00	1.00	1.20	1.00	900.00	540.00
10	0.00	1.00	1.20	1.00	1000.00	600.00
11	0.00	1.00	1.20	1.00	1100.00	660.00
12	0.00	1.00	1.20	1.00	1200.00	720.00

YEAR	LP	NC	N	NN	NOH	PSS
1	120.00	24.00	10.00	10.00	0.00	0.00
2	240.00	0.00	20.00	10.00	0.00	0.00
3	360.00	0.00	30.00	10.00	0.00	0.00
4	480.00	0.00	40.00	10.00	0.00	0.00
5	600.00	0.00	50.00	10.00	10.00	0.00
6	720.00	0.00	60.00	10.00	10.00	0.00
7	840.00	0.00	70.00	10.00	10.00	0.00
8	960.00	0.00	80.00	10.00	10.00	0.00
9	1080.00	0.00	90.00	10.00	20.00	0.00
10	1200.00	0.00	100.00	10.00	20.00	0.00
11	1320.00	0.00	110.00	10.00	20.00	0.00
12	1440.00	0.00	120.00	10.00	20.00	0.00

YEAR	PTI	PTM	PTD	PTP	STE	INF
1	2.00	20.00	2.00	20.00	0.00	1.00
2	2.00	20.00	2.00	20.00	0.00	1.11
3	2.00	20.00	2.00	20.00	0.00	1.17
4	2.00	20.00	2.00	20.00	0.00	1.24
5	2.00	20.00	2.00	20.00	0.00	1.31
6	2.00	20.00	2.00	20.00	0.00	1.38
7	2.00	20.00	2.00	20.00	0.00	1.46
8	2.00	20.00	2.00	20.00	0.00	1.54
9	2.00	20.00	2.00	20.00	0.00	1.62
10	2.00	20.00	2.00	20.00	0.00	1.71
11	2.00	20.00	2.00	20.00	0.00	1.80
12	2.00	20.00	2.00	20.00	0.00	1.90

YEAR	TDP	PET
1	0.00	10.00
2	0.00	10.00
3	0.00	10.00
4	0.00	10.00
5	0.00	10.00
6	0.00	10.00
7	0.00	10.00
8	0.00	10.00
9	0.00	10.00
10	0.00	10.00
11	0.00	10.00
12	0.00	10.00

5

VARIANCE GROUP NO. 1: CHANGE= .2500 LIMIT= .0100 6

YEAR	PEA	PMG	ISA	SUP	LCC			
----	---	---	---	---	---			
INF	385162.	2851.	1479399.	1184533.	3051945.	HI	25.00	1
INF	231097.	1710.	887640.	710720.	1831167.	LOW	25.00	1
NPM	308130.	2280.	1183520.	1128995.	2622925.	LOW	7.43	1
OT	308130.	2280.	1183529.	1083752.	2577691.	HI	5.58	1
OT	308130.	2280.	1183510.	811502.	2305422.	LOW	5.58	1
N	308130.	2280.	1183520.	1083757.	2577687.	HI	5.58	1
N	308130.	2280.	1183520.	811496.	2305426.	LOW	5.58	1
CTM	308130.	2280.	1302069.	964655.	2577134.	HI	5.55	1
CTM	308130.	2280.	1064970.	930598.	2305978.	LOW	5.55	1
PTM	308130.	2280.	1302069.	947627.	2560106.	HI	4.86	1
PTM	308130.	2280.	1064970.	947627.	2323007.	LOW	4.86	1
MPM	308130.	2280.	1183520.	1062663.	2556593.	HI	4.71	1
MPM	308130.	2280.	1183520.	832590.	2326520.	LOW	4.71	1
NPM	308130.	2280.	1183520.	838805.	2332735.	HI	4.46	1
CTI	308130.	2280.	1262552.	947627.	2520589.	HI	3.24	1
CTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
PTI	308130.	2280.	1262552.	947627.	2520589.	HI	3.24	1
PTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
CTP	308130.	2280.	1242794.	952887.	2506091.	HI	2.64	1
CTP	308130.	2280.	1124245	942367.	2377022.	LOW	2.64	1
CU	369792.	2280.	1183520	947627.	2503219.	HI	2.53	1
[illegible]	246467.	2280.	1183520.	947627.	2379894.	LOW	2.53	1
[illegible]	369792.	2280.	1183529.	947627.	2503229.	HI	2.53	1
NN	246467.	2280.	1183510.	947627.	2379884.	LOW	2.53	1
PTP	308130.	2220.	1242794.	947627.	2500831.	HI	2.43	1
PTP	308130.	2220.	1124245.	947627.	2382282.	LOW	2.43	1
NOH	308130.	2280.	1183520.	1003395.	2497325.	HI	2.28	
NOH	308130.	2280.	1183520.	891858.	2385788.	LOW	2.28	1
OHM	308130.	2220.	1183520.	988607.	2482536.	HI	1.68	1
OHM	308130.	2260.	1183520.	906646.	2400576.	LOW	1.68	1
CTO	308130.	2280.	1203278.	964655.	2478343.	HI	1.51	1
CTO	308130.	2280.	1163761.	930598.	2404770.	LOW	1.51	1
FAM	308130.	2280.	1183520.	981684.	2475613.	HI	1.39	1
FAM	308130.	2280.	1183520.	913569.	2407499.	LOW	1.39	1

READY.

PART DATA? YES

7

PART	CST	DC	DSC	QTY	R	RSS	RW
1	1200.00	1.0000	.5000	1.	83000.	.9900	1.2000
2	2.71	1.0000	1.0000	1.	5200.	.9900	1.2000
3	690.15	1.0000	.9000	1.	99999999.	.9900	1.2000
4	36.36	1.0000	.9000	1.	27000.	.9900	1.2000
PART	W	LSO	LSD	LSI	RF	CDG	PLT
1	500.00	8.00	0.00	0.00	.0104	9C	9.00
2	.50	.50	0.00	0.00	.0638	96	9.00
3	50.00	4.00	0.00	0.00	.0135	96	9.00
4	50.00	4.00	0.00	0.00	.0390	96	9.00
PART	SL	TOR	MPU	PSC	PMR	WSAVL	OBSA
1	36.	◆◆	.75	PA@@	1.	0.0000	0.0000
2	36.	◆◆	.75	PF@@	1.	0.0000	.7500
3	36.	◆◆	.75	PF@@	1.	0.0000	0.0000
4	36.	◆◆	.75	PB@@	1.	0.0000	.7500

OLD,B7
READY.
LNH

8

		SUBTOTAL GROUP NUMBER	1	
PMGG	0.	0.	0.0000	1
PMGH	0.	0.	0.0000	1
PMGI	0.	0.	0.0000	1
PMGJ	0.	0.	0.0000	1
PMGK	0.	0.	0.0000	1
PMGL	0.	0.	0.0000	1
PMGM	0.	0.	0.0000	1
TCU	38020.	344640.	50.2511	1
TPHB	0.	28.	.0040	1
TPHC	0.	28.	.0040	1
TPHF	0.	0.	0.0000	1
TPHH	0.	28.	.0040	1
TPHR	0.	0.	0.0000	1
TPSS	0.	0.	0.0000	1
EPT	0.	0.	0.0000	1
TD	0.	0.	0.0000	1
RTD	0.	0.	0.0000	1
TSTE	0.	0.	0.0000	1
SPE	0.	0.	0.0000	1
SSTE	0.	0.	0.0000	1
APLE	0.	0.	0.0000	1
NSNE	0.	0.	0.0000	1
AD	0.	0.	0.0000	1
TNC	0.	0.	0.0000	1
TPTO	83.	753.	.1097	1
TPTM	830.	7527.	1.0975	1
TPTP	830.	7527.	1.0975	1
TPTI	83.	753.	.1097	1
TATU	0.	140.	.0204	1
CMPR	0.	0.	0.0000	1
CMOI	0.	0.	0.0000	1
CMD	0.	0.	0.0000	1
CMRM	0.	0.	0.0000	1
TPMH	0.	0.	0.0000	1
TPPM	0.	0.	0.0000	1
TPSH	0.	0.	0.0000	1
PML	2100.	11345.	1.6542	1
PMM	1690.	9131.	1.3313	1
NOHL	4663.	24204.	3.5292	1
NOHM	7604.	39472.	5.7553	1
NOHT	295.	1530.	.2230	1
STM	0.	0.	0.0000	1
TISSI	0.	0.	0.0000	1
TISSD	0.	0.	0.0000	1
DM	0.	0.	0.0000	1
SSRS	0.	0.	0.0000	1
SSM	0.	0.	0.0000	1
LD	13452.	72686.	10.5981	1
LM	22420.	121143.	17.6636	1
LP	8310.	44904.	6.5473	1

READY.

```
OLD,LCCX
READY.
GET,TAPE1=070971
READY.
GET,TAPE2=VARNAM
READY.
GET,TAPE3=070973
READY.
GET,TAPE4=070974
READY.
GET,TAPE5=070975
READY.
FTNTS
READY.
SBULIM,JS=900
READY.
RUN,MA=77777

 80/01/09. 11.05.42.
PROGRAM   LCCX

END OF SINGLE VARIABLE INITIALIZATION.
ENTER NEW VARIABLES & VALUES OR SPACE, THEN RETURN.
? SEM  =1.0
? CU   =1800.
? HRG  =10.
? HRH  =2.
? HRI  =2.
? HRJ  =2.
? HRK  =4.
? HRM  =14.
? HRT  =30.
? NHB  =2.
? NHC  =1.5
? NHF  =10.
? NSNP =1.
? OHL  =4.2
? OHM  =360.
? PHT  =1.
? POPZ =0.
? PTC  =400.
? MAT
```

1

SSM

NONSTANDARD C/E

2

```
***MATRIX DATA ENTRY MODE***

...VALUE ENTRIES REQUIRED...

MATRIX NAME ? STE
    INDEX? 1.
    VALUE? 10800.

MATRIX NAME ? TDP
    INDEX? 1.
    VALUE? 4.

MATRIX NAME ? ATU
    INDEX? 1.
    VALUE? 1800.

MATRIX NAME ? P-ON

%%%PERCENTAGE ENTRIES REQUIRED%%%

MATRIX NAME ? PTI
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? PTM
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? PTD
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? PTP
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? CST
    INDEX? 0.
    VALUE? 10.

MATRIX NAME ? LPM
    INDEX? 0.
    VALUE? 5.

MATRIX NAME ? MPM
    INDEX? 0.
    VALUE? 10.

MATRIX NAME ? NPM
    INDEX? 0.
    VALUE? -10.
```

2

MATRIX NAME ? SINGL
ENTER NEW VARIABLES & VALUES OR SPACE, THEN RETURN.
?

YEAR	PEA	PMG	ISA	SUP	LCC	
1	18421.	0.	2809.	2135.	23365.	
2	20034.	0.	1123.	4752.	25909.	
3	21132.	0.	1185.	7518.	29835.	
4	22302.	0.	1250.	10579.	34132.	
5	23526.	0.	1319.	20440.	45284.	
6	24822.	0.	1391.	24509.	50723.	3
7	26190.	0.	1468.	28966.	56624.	
8	27630.	0.	1549.	33836.	63014.	
9	29142.	0.	1634.	47182.	77957.	
10	30744.	0.	1723.	53422.	85889.	
11	32436.	0.	1818.	60208.	94463.	
12	34218.	0.	1918.	67574.	103710.	
TOTAL	310597.	0.	19187.	361121.	690906.	

SUBTOTAL GROUP NO. 1 DUMPED TO TAPE7.
DO YOU WANT SUBTOTALS PRINTED HERE? NO

DO YOU WANT VARIANCES CALCULATED? YES
WHAT IS VARIANCE PERCENTAGE? 25.
WHAT IS MINIMUM % LCC CHANGE OF CONCERN? 1.

VARIANCES BEING CALCULATED...
VARIANCE GROUP NO. 1: CHANGE= .2500 LIMIT= .0100
27 VARIANCES HIGHER THAN LIMIT WRITTEN TO TAPE6.
WOULD YOU LIKE TO CHANGE VARIABLE VALUES AND CALCULATE ANOTHER LCC? NO

```
WOULD YOU LIKE DATA LISTINGS? YES                                4

 SINGLE VALUE DATA? YES
 AAM  =        11.00  ◆  HRG   =         10.00  ◆  NSNP =        1.00
 ACDP =         2.00  ◆        =          0.00  ◆  NSNS =        0.00
 ACP  =         7.00  ◆  HRH   =          2.00  ◆  DHL  =        4.20
 AHA  =        27.50  ◆  HRI   =          2.00  ◆       =        0.00
 ANM  =       225.00  ◆  HRJ   =          2.00  ◆  DHM  =      360.00
      =         0.00  ◆  HRK   =          4.00  ◆  DHT  =        7.75
 CACD =      1250.00  ◆  HRM   =         14.00  ◆  DT   =     2000.00
 CACP =       338.00  ◆        =          0.00  ◆  PAPL =        3.00
 CEDB =        10.00  ◆  HRN   =         22.56  ◆  POPOB=        0.00
 CHCD =      2500.00  ◆  HRT   =         30.00  ◆       =        0.00
 CHCP =       367.00  ◆  K     =          4.00  ◆  PHS  =       22.56
      =         0.00  ◆  LBB   =         26.82  ◆  PHT  =        1.00
 CNP  =       455.00  ◆  LBC   =         26.88  ◆  POPZ =        0.00
 CP   =          .06  ◆        =          0.00  ◆  PPC  =      169.00
 CPL  =        13.34  ◆  LBE   =         26.88  ◆  PTC  =      400.00
 CSD  =         3.47  ◆  N     =          2.00  ◆       =        0.00
 CSI  =        43.66  ◆  NAP   =          1.00  ◆  RAM  =         .45
      =         0.00  ◆  NAPL  =          4.00  ◆  RAP  =         .14
 CTI  =        21.84  ◆  NAPS  =          0.00  ◆  RDM  =       18.60
 CTM  =        21.84  ◆        =          0.00  ◆  RPL  =        1.80
 CTO  =        21.84  ◆  NHB   =          2.00  ◆  RPM  =        1.79
 CTP  =        21.84  ◆  NHC   =          1.50  ◆  RSD  =       30.66
 CU   =      1800.00  ◆  NHF   =         10.00  ◆  RSL  =        9.94
      =         0.00  ◆  NHH   =          1.00  ◆  RSR  =         .50
 FM   =          .11  ◆  NK    =          4.00  ◆  SHIPS=       12.00
 FPST =       802.00  ◆        =          0.00  ◆  STEM =         .26
 HCDP =         0.00  ◆  NM    =          2.00  ◆  STES =         .12
 HCP  =         1.00  ◆  NP    =         10.00  ◆  Y    =       12.00
```

YEAR DATA? YES

YEAR	ATU	FR	ISSD	ISSI	LM	LD
1	1800.00	1.00	1.20	1.00	100.00	60.00
2	0.00	1.00	1.20	1.00	200.00	120.00
3	0.00	1.00	1.20	1.00	300.00	180.00
4	0.00	1.00	1.20	1.00	400.00	240.00
5	0.00	1.00	1.20	1.00	500.00	300.00
6	0.00	1.00	1.20	1.00	600.00	360.00
7	0.00	1.00	1.20	1.00	700.00	420.00
8	0.00	1.00	1.20	1.00	800.00	480.00
9	0.00	1.00	1.20	1.00	900.00	540.00
10	0.00	1.00	1.20	1.00	1000.00	600.00
11	0.00	1.00	1.20	1.00	1100.00	660.00
12	0.00	1.00	1.20	1.00	1200.00	720.00
YEAR	LP	NC	N	NN	NOH	PSS
1	120.00	24.00	10.00	10.00	0.00	0.00
2	240.00	0.00	20.00	10.00	0.00	0.00
3	360.00	0.00	30.00	10.00	0.00	0.00
4	480.00	0.00	40.00	10.00	0.00	0.00
5	600.00	0.00	50.00	10.00	10.00	0.00
6	720.00	0.00	60.00	10.00	10.00	0.00
7	840.00	0.00	70.00	10.00	10.00	0.00
8	960.00	0.00	80.00	10.00	10.00	0.00
9	1080.00	0.00	90.00	10.00	20.00	0.00
10	1200.00	0.00	100.00	10.00	20.00	0.00
11	1320.00	0.00	110.00	10.00	20.00	0.00
12	1440.00	0.00	120.00	10.00	20.00	0.00
YEAR	PTI	PTM	PTO	PTP	STE	INF
1	2.10	21.00	2.10	21.00	10800.00	1.00
2	2.10	21.00	2.10	21.00	0.00	1.11
3	2.10	21.00	2.10	21.00	0.00	1.17
4	2.10	21.00	2.10	21.00	0.00	1.24
5	2.10	21.00	2.10	21.00	0.00	1.31
6	2.10	21.00	2.10	21.00	0.00	1.38
7	2.10	21.00	2.10	21.00	0.00	1.46
8	2.10	21.00	2.10	21.00	0.00	1.54
9	2.10	21.00	2.10	21.00	0.00	1.62
10	2.10	21.00	2.10	21.00	0.00	1.71
11	2.10	21.00	2.10	21.00	0.00	1.80
12	2.10	21.00	2.10	21.00	0.00	1.90
YEAR	TDP	PET				
1	4.00	10.00				
2	0.00	10.00				
3	0.00	10.00				
4	0.00	10.00				
5	0.00	10.00				
6	0.00	10.00				
7	0.00	10.00				
8	0.00	10.00				
9	0.00	10.00				
10	0.00	10.00				
11	0.00	10.00				
12	0.00	10.00				

5

VARIANCE GROUP NO. 1: CHANGE= .2500 LIMIT= .0100

6

YEAR	PEA	PMG	ISA	SUP	LCC			
----	---	---	---	---	---			
INF	385162.	2851.	1479399.	1184533.	3051945.	HI	25.00	1
INF	231097.	1710.	887640.	710720.	1831167.	LOW	25.00	1
NPM	308130.	2280.	1183520.	1128995.	2622925.	LOW	7.43	1
DT	308130.	2280.	1183529.	1083752.	2577691.	HI	5.58	1
DT	308130.	2280.	1183510.	811502.	2305422.	LOW	5.58	1
N	308130.	2280.	1183520.	1083757.	2577687.	HI	5.58	1
N	308130.	2280.	1183520.	811496.	2305426.	LOW	5.58	1
CTM	308130.	2280.	1302069.	964655.	2577134.	HI	5.55	1
CTM	308130.	2280.	1064970.	930598.	2305978.	LOW	5.55	1
PTM	308130.	2280.	1302069.	947627.	2560106.	HI	4.86	1
PTM	308130.	2280.	1064970.	947627.	2323007.	LOW	4.86	1
MPM	308130.	2280.	1183520.	1062663.	2556593.	HI	4.71	1
MPM	308130.	2280.	1183520.	832590.	2326520.	LOW	4.71	1
NPM	308130.	2280.	1183520.	838805.	2332735.	HI	4.46	1
CTI	308130.	2280.	1262552.	947627.	2520589.	HI.	3.24	1
CTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
PTI	308130.	2280.	1262552.	947627.	2520589.	HI	3.24	1
PTI	308130.	2280.	1104487.	947627.	2362523.	LOW	3.24	1
CTP	308130.	2280.	1242794.	952887.	2506091.	HI	2.64	1
CTP	308130.	2280.	1124245.	942367.	2377022.	LOW	2.64	1
CU	369792.	2280.	1183520.	947627.	2503219.	HI	2.53	1
CU	246467.	2280.	1183520.	947627.	2379894.	LOW	2.53	1
NN	369792.	2280.	1183529.	947627.	2503229.	HI	2.53	1
NN	246467.	2280.	1183510.	947627.	2379884.	LOW	2.53	1
PTP	308130.	2280.	1242794.	947627.	2500831.	HI	2.43	1
PTP	308130.	2280.	1124245.	947627.	2392282.	LOW	2.43	1
NOH	308130.	2280.	1183520.	1003395.	2497325.	HI	2.28	1
NOH	308130.	2280.	1183520.	891858.	2385788.	LOW	2.28	1
OHM	308130.	2280.	1183520.	988607.	2482536.	HI	1.68	1
OHM	308130.	2280.	1183520.	906646.	2400576.	LOW	1.68	1
CTO	308130.	2280.	1203278.	964655.	2478343.	HI	1.51	1
CTO	308130.	2280.	1163761.	930598.	2404770.	LOW	1.51	1
RAM	308130.	2280.	1183520.	981684.	2475613.	HI	1.39	1
RAM	308130.	2280.	1183520.	913569.	2407499.	LOW	1.39	1

READY.

PART DATA? YES

7

PART	CST	DC	DSC	QTY	R	RSS	RW
1	1320.00	1.0000	.5000	1.	83000.	.9900	1.2000
2	2.98	1.0000	1.0000	1.	5200.	.9900	1.2000
3	759.17	1.0000	.9000	1.	99999999.	.9900	1.2000
4	40.00	1.0000	.9000	1.	27000.	.9900	1.2000
PART	W	LSO	LSD	LSI	RF	COG	PLT
1	500.00	8.00	0.00	0.00	.0104	9C	9.00
2	.50	.50	0.00	0.00	.0638	9G	9.00
3	50.00	4.00	0.00	0.00	.0135	9G	9.00
4	50.00	4.00	0.00	0.00	.0390	9G	9.00
PART	SL	TOR	MRU	PSC	PMR	WSAVL	OBSA
1	36.	◆◆	.75	PA@@	1.	0.0000	0.0000
2	36.	◆◆	.75	PF@@	1.	0.0000	.7500
3	36.	◆◆	.75	PF@@	1.	0.0000	0.0000
4	36.	◆◆	.75	PB@@	1.	0.0000	.7500

OLD,B7
READY.
LNH

B

SUBTOTAL GROUP NUMBER 1

PMGG	0.	0.	0.0000	1
PMGH	0.	0.	0.0000	1
PMGI	0.	0.	0.0000	1
PMGJ	0.	0.	0.0000	1
PMGK	0.	0.	0.0000	1
PMGL	0.	0.	0.0000	1
PMGM	0.	0.	0.0000	1
TCU	34218.	310176.	44.8941	1
TPHB	0.	55.	.0080	1
TPHC	0.	41.	.0060	1
TPHF	0.	275.	.0398	1
TPHH	0.	28.	.0040	1
TPHR	0.	23.	.0033	1
TPSS	0.	0.	0.0000	1
EPT	0.	0.	0.0000	1
TD	0.	0.	0.0000	1
PTD	0.	0.	0.0000	1
TSTE	0.	0.	0.0000	1
SPE	0.	0.	0.0000	1
SSTE	0.	0.	0.0000	1
APLE	0.	0.	0.0000	1
NSNE	0.	0.	0.0000	1
AD	0.	0.	0.0000	1
TNC	0.	0.	0.0000	1
TPTD	87.	790.	.1144	1
TPTM	872.	7903.	1.1439	1
TPTP	872.	7903.	1.1439	1
TPTI	87.	790.	.1144	1
TATU	0.	1800.	.2605	1
CMRR	0.	0.	0.0000	1
CMOI	0.	0.	0.0000	1
CMD	0.	0.	0.0000	1
CMRM	0.	0.	0.0000	1
TPMH	0.	0.	0.0000	1
TPPM	0.	0.	0.0000	1
TPSH	0.	0.	0.0000	1
PML	2449.	13236.	1.9157	1
PMM	2065.	11160.	1.6152	1
NOHL	4896.	25414.	3.6784	1
NOHM	13687.	71050.	10.2835	1
NOHT	295.	1530.	.2214	1
STM	0.	0.	0.0000	1
TISSI	0.	0.	0.0000	1
TISSD	0.	0.	0.0000	1
DM	0.	0.	0.0000	1
SSRS	0.	0.	0.0000	1
SSM	0.	0.	0.0000	1
LD	13452.	72686.	10.5204	1
LM	22420.	121143.	17.5339	1
LP'	8310.	44904.	6.4992	1

READY.

APPENDIX E

STANDARDIZATION LIFE-CYCLE ELEMENT COSTS BY MODEL

This appendix provides model results for each of the 20 study C/Es (Table E-1), exercised with both the Enhanced SLCCM and the SSM. The SLCC results are presented for each cost element, with a comparison of the differences derived for standard and nonstandard C/E configurations.

Table E-1. STANDARDIZATION LIFE-CYCLE ELEMENT COSTS BY MODEL ($ Thousands)

Component/Equipment: Meter, Liquid -- APL 109030049

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	2	2	2	2	0	0
Production Support and Services	*		*		0	
Production Test and Equipment	1		4		3	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		1		0	
Documentation	2		2		0	
Training	7	7	7	7	0	0
Follow-On Support						
Corrective Maintenance	1		1		0	
Preventive Maintenance	2	2	2	2	0	0
Overhaul	5	5	6	6	1	1
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	1		1		0	
Supply Support	*		4		4	
Training	21	21	21	21	0	0

* = Less than $500

(continued)

Table E-1. (continued)

Component/Equipment: Fan, Centrifugal -- APL 400060902B

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	16	16	15	15	(1)**	(1)
Production Support and Services	*		*		0	
Production Test and Equipment	2		7		5	
Initial Support Acquisition						
Support and Test Equipment Acquisition	*		1		1	
Documentation	6		6		0	
Training	18	18	18	18	0	0
Follow-On Support						
Corrective Maintenance	5		5		0	
Preventive Maintenance	8	8	10	10	2	2
Overhaul	6	6	6	6	0	0
Support and Test Equipment Maintenance	*		*		0	
Facilities	8		8		0	
Document Maintenance	4		4		0	
Supply Support	*		4		4	
Training	13	13	13	13	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Motor, Pneumatic -- APL 330200005

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	21	21	19	19	(2)**	(2)
Production Support and Services	*		*		0	
Production Test and Equipment	5		22		17	
Initial Support Acquisition						
Support and Test Equipment Acquisition	*		1		1	
Documentation	5		5		0	
Training	18	18	19	19	1	1
Follow-On Support						
Corrective Maintenance	2		2		0	
Preventive Maintenance	70	70	82	82	12	12
Overhaul	3	3	3	3	0	0
Support and Test Equipment Maintenance	*		*		0	
Facilities	*		*		0	
Document Maintenance	2		2		0	
Supply Support	27		33		6	
Training	81	81	81	81	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Motor, 440V AC -- APL 174031359B

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*				1	
Prime Equipment Acquisition			1			
Production Hardware	147	147	133	133	(14)**	(14)
Production Support and Services	*		*		0	
Production Test and Equipment	2		2		0	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		7		6	
Documentation	7		7		0	
Training	51	51	53	53	2	2
Follow-On Support						
Corrective Maintenance	1		1		0	
Preventive Maintenance	39	39	46	46	7	7
Overhaul	4	4	5	5	1	1
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	3		3		0	
Supply Support	1		5		4	
Training	46	46	46	46	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Unit Heater, Air -- APL 070970004

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	345	345	311	311	(34)**	(34)
Production Support and Services	*		*		0	
Production Test and Equipment	17		70		53	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		15		14	
Documentation	5		5		0	
Training	17	17	19	19	2	2
Follow-On Support						
Corrective Maintenance	10		11		1	
Preventive Maintenance	20	20	24	24	4	4
Overhaul	65	65	98	98	33	33
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	3		3		0	
Supply Support	22		28		6	
Training	239	239	239	239	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Starter Motor -- APL 151030137

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	6	6	6	6	0	0
Production Support and Services	*		*		0	
Production Test and Equipment	1		6		5	
Initial Support Acquisition						
Support and Test Equipment Acquisition	*		1		1	
Documentation	4		4		0	
Training	12	12	12	12	0	0
Follow-On Support						
Corrective Maintenance	*		*		0	
Preventive Maintenance	1	1	1	1	0	0
Overhaul	30	30	32	32	2	2
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	2		2		0	
Supply Support	*		4		4	
Training	5	5	5	5	0	0

* = Less than $500.

(continued)

AD-A083 760 ARINC RESEARCH CORP ANNAPOLIS MD F/G 14/1
IMPROVEMENT TO THE STANDARDIZATION LIFE-CYCLE-COST MODEL FOR HU--ETC(U)
MAR 80 M GARDNER N00024-79-C-2683
UNCLASSIFIED 1662-04-3-2165 NL

2 OF 2
AD A
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END
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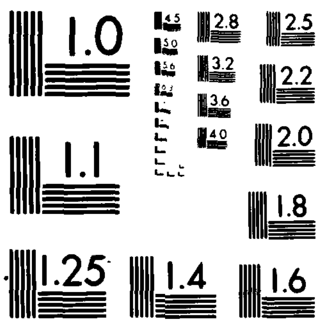

MICROCOPY RESOLUTION TEST CHART

Table E-1. (continued)

Component/Equipment: Motor AC/2-SPD -- APL 174720568

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	24	24	22	22	(2)**	(2)
Production Support and Services	*		*		0	
Production Test and Equipment	2		8		6	
Initial Support Acquisition						
Support and Test Equipment Acquisition	7		9		2	
Documentation	4		4		0	
Training	17	17	17	17	0	0
Follow-On Support						
Corrective Maintenance	1		1		1	
Preventive Maintenance	36	36	43	43	7	7
Overhaul	*	*	*	*	0	0
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	2		2		0	
Supply Support	*		4		4	
Training	7	7	7	7	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Valve, Solenoid -- APL 882182585B

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	5	5	5	5	0	0
Production Support and Services	*		*		0	
Production Test and Equipment	1		6		5	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		2		1	
Documentation	3		3		0	
Training	5	5	5	5	0	0
Follow-On Support						
Corrective Maintenance	*		*		0	
Preventive Maintenance	12	12	15	15	3	3
Overhaul	34	34	38	38	4	4
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	1		1		0	
Supply Support	2		6		4	
Training	2	2	2	2	0	0

* = Less than $500.

(continued)

Table E-1. (continued)

Component/Equipment: Pump, Rotary -- APL 016021435

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	345	345	312	312	(33)**	(33)
Production Support and Services	*		*		0	
Production Test and Equipment	7		30		23	
Initial Support Acquisition						
Support and Test Equipment Acquisition	17		34		17	
Documentation	9		9		0	
Training	25	25	26	26	1	1
Follow-On Support						
Corrective Maintenance	53		56		3	
Preventive Maintenance	181	181	214	214	33	33
Overhaul	74	74	112	112	33	33
Support and Test Equipment Maintenance	*		*		0	
Facilities	15		15		0	
Document Maintenance	5		5		0	
Supply Support	5		9		4	
Training	46	46	46	46	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Coupling Shaft -- APL 780030009

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced *SLCCM*	SSM	Enhanced *SLCCM*	SSM	Enhanced *SLCCM*	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	12	12	12	12	0	0
Production Support and Services	*		*		0	
Production Test and Equipment	1		4		3	
Initial Support Acquisition						
Support and Test Equipment Acquisition	3		3		0	
Documentation	4		4		0	
Training	5	5	5	5	0	0
Follow-On Support						
Corrective Maintenance	1		1		0	
Preventive Maintenance	9	9	10	10	1	1
Overhaul	6	6	7	7	1	1
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	1		1		0	
Supply Support	*		4		4	
Training	14	14	14	14	0	0

* = Less than $500.

(continued)

Table E-1. (continued)

Component/Equipment: Valve, Reducing -- APL 882094626

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		2		2	
Prime Equipment Acquisition						
Production Hardware	6	6	7	7	1	1
Production Support and Services	*		*		0	
Production Test and Equipment	2		8		6	
Initial Support Acquisition						
Support and Test Equipment Acquisition	*		1		1	
Documentation	4		4		0	
Training	7	7	7	7	0	0
Follow-On Support						
Corrective Maintenance	1		1		0	
Preventive Maintenance	8	8	10	10	2	2
Overhaul	17	17	21	21	4	4
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	1		1		0	
Supply Support	1		4		3	
Training	5	5	5	5	0	0

* = Less than $500.

(continued)

Table E-1. (continued)

Component/Equipment: Switch, Selector -- APL 212104133

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		1		1	
Prime Equipment Acquisition						
Production Hardware	1	1	1	1	0	0
Production Support and Services	*		*		0	
Production Test and Equipment	*		1		1	
Initial Support Acquisition						
Support and Test Equipment Acquisition	*		*		0	
Documentation	3		3		0	
Training	2	2	2	2	0	0
Follow-On Support						
Corrective Maintenance	*		*		0	
Preventive Maintenance	1	1	1	1	0	0
Overhaul	*	*	*	*	0	0
Support and Test Equipment Maintenance	*		*		0	
Facilities	*		*		0	
Document Maintenance	1		1		0	
Supply Support	*		4		4	
Training	1	1	1	1	0	0

* = Less than $500.

(continued)

Table E-1. (continued)

Component/Equipment: Compressor, Refrigeration -- APL 060030001

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		3		3	
Prime Equipment Acquisition						
Production Hardware	8	8	9	9	1	1
Production Support and Services	*		*		0	
Production Test and Equipment	1		8		7	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		1		0	
Documentation	13		13		0	
Training	10	10	10	10	0	0
Follow-On Support						
Corrective Maintenance	3		3		0	
Preventive Maintenance	85	85	101	101	16	16
Overhaul	10	10	11	11	1	1
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	8		8		0	
Supply Support	*		4		4	
Training	13	13	13	13	0	0

* = Less than $500.

(continued)

Table E-1. (continued)

Component/Equipment: Power Supply, 440V AC -- APL 111610018

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		2		2	
Prime Equipment Acquisition						
Production Hardware	21	21	20	20	(1)**	(1)
Production Support and Services	*		*		0	
Production Test and Equipment	2		9		7	
Initial Support Acquisition						
Support and Test Equipment Acquisition	*		3		3	
Documentation	16		16		0	
Training	39	39	41	41	2	2
Follow-On Support						
Corrective Maintenance	1		1		0	
Preventive Maintenance	41	41	48	48	7	7
Overhaul	36	36	42	42	6	6
Support and Test Equipment Maintenance	*		*		0	
Facilities	2		2		0	
Document Maintenance	11		11		0	
Supply Support	1		5		4	
Training	10	10	10	10	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Controller, AC -- APL 151406772C

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		2		2	
Prime Equipment Acquisition						
Production Hardware	35	35	33	33	(2)**	(2)
Production Support and Services	*		*		0	
Production Test and Equipment	4		17		13	
Initial Support Acquisition						
Support and Test Equipment Acquisition	3		5		2	
Documentation	18		18		0	
Training	84	84	88	88	4	4
Follow-On Support						
Corrective Maintenance	3		3		0	
Preventive Maintenance	159	159	188	188	29	29
Overhaul	32	32	37	37	4	4
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	10		10		0	
Supply Support	13		18		5	
Training	157	157	157	157	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Pump, Centrifugal -- APL 016035130

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		2		2	
Prime Equipment Acquisition						
Production Hardware	414	414	374	374	(40)**	(40)
Production Support and Services	*		*		0	
Production Test and Equipment	35		73		38	
Initial Support Acquisition						
Support and Test Equipment Acquisition	20		38		18	
Documentation	43		43		0	
Training	96	96	99	99	3	3
Follow-On Support						
Corrective Maintenance	7		8		1	
Preventive Maintenance	70	70	85	85	15	15
Overhaul	128	128	179	179	51	51
Support and Test Equipment Maintenance	*		*		0	
Facilities	4		4		0	
Document Maintenance	17		17		0	
Supply Support	2		6		4	
Training	129	129	129	129	0	0

* = Less than $500. **( ) = Nonstandard is less than standard.

(continued)

Table E-1. (continued)

Component/Equipment: Panel-Monitor -- APL 506330001

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		3		3	
Prime Equipment Acquisition						
Production Hardware	21	21	21	21	0	0
Production Support and Services	*		*		0	
Production Test and Equipment	5		13		8	
Initial Support Acquisition						
Support and Test Equipment Acquisition	1		2		1	
Documentation	11		11		0	
Training	109	109	114	114	5	5
Follow-On Support						
Corrective Maintenance	7		7		0	
Preventive Maintenance	63	63	74	74	11	11
Overhaul	46	46	50	50	4	4
Support and Test Equipment Maintenance	*		*		0	
Facilities	*		*		0	
Document Maintenance	5		5		0	
Supply Support	2		6		4	
Training	336	336	336	336	0	0

* = Less than $500.

(continued)

Table E-1. (continued)

Component/Equipment: Console, Control -- APL 612200051C

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		3		3	
Prime Equipment Acquisition						
Production Hardware	431	431	390	390	(41)**	(41)
Production Support and Services	*		*		0	
Production Test and Equipment	17		60		43	
Initial Support Acquisition						
Support and Test Equipment Acquisition	93		152		60	
Documentation	30		30		0	
Training	430	430	449	449	19	19
Follow-On Support						
Corrective Maintenance	7		8		1	
Preventive Maintenance	50	50	59	59	9	9
Overhaul	110	110	170	170	60	60
Support and Test Equipment Maintenance	*		*		0	
Facilities	*		*		0	
Document Maintenance	14		14		0	
Supply Support	22		28		6	
Training	511	511	511	511	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Gear Assembly -- APL 691300156X

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		4		4	
Prime Equipment Acquisition						
Production Hardware	10,399	10,399	9,308	9,308	(1,091)**	(1,091)
Production Support and Services	*	*			0	
Production Test and Equipment	35		145		110	
Initial Support Acquisition						
Support and Test Equipment Acquisition	4,741		6,403		1,662	
Documentation	32		32		0	
Training	2,181	2,181	2,200	2,200	19	19
Follow-On Support						
Corrective Maintenance	207		227		20	
Preventive Maintenance	704	704	828	828	124	124
Overhaul	126	126	218	218	92	92
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	18		18		0	
Supply Support	70		81		11	
Training	637	637	637	637	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

(continued)

Table E-1. (continued)

Component/Equipment: Compressor -- APL 061900283

Element	Standard		Nonstandard		Difference (Standard vs. Nonstandard)	
	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM	Enhanced SLCCM	SSM
Government Program Management	*		4		4	
Prime Equipment Acquisition						
Production Hardware	311	311	282	282	(29)**	(29)
Production Support and Services	*		*		0	
Production Test and Equipment	9		37		26	
Initial Support Acquisition						
Support and Test Equipment Acquisition	26		48		22	
Documentation	7		7		0	
Training	471	471	493	493	22	22
Follow-On Support						
Corrective Maintenance	1		1		0	
Preventive Maintenance	20	20	24	24	4	4
Overhaul	225	225	302	302	77	77
Support and Test Equipment Maintenance	*		*		0	
Facilities	1		1		0	
Document Maintenance	3		3		0	
Supply Support	*		4		4	
Training	175	175	175	175	0	0

* = Less than $500. **( ) = Nonstandard is less than Standard.

APPENDIX F

STANDARD COMPONENTS LIST CATEGORIZATION

The Standard Components List presented in this appendix is the reformatted Nomenclature Index resulting from the categorization effort. Approximately 1,000 C/Es were selected from the 1 October 1978 SCL to form this index. The Nomenclature remains the same as in the 1978 SCL. The HM&E WBS Category and the Complexity Category columns have been added. Page numbers would be included during the machine-run compilation. HM&E WBS Category derivations have been accomplished through judgmental assignments.

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Control-Master Sender	Electrical Systems	C	
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Control-Overload	Electrical Systems	C	
Control-Panel	Electrical Systems	C	
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Control-Station	Deck and Hull Machinery	D	
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Control-System Fueling	Fluid Systems	C	
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Control-Thermostatic	Electrical Systems	B	
Control-Timer	Electrical Systems	D	
Control-Transmitter Differential Pressure	Fluid Systems	D	
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Valve-Pressure Regulating, Special Design	Fluid Systems	C	
Valve-Pressure Regulating, Water Flow	Fluid Systems	C	
Valve-Quick Release	Fluid Systems	B	
Valve-Reducing and Relief, Level 1	Fluid Systems	C	
Valve-Reducing and Relief, Special Design	Fluid Systems	B	
Valve-Reducing and Stop, Special Design	Fluid Systems	B	
Valve-Reducing, Special Design	Fluid Systems	D	
Valve-Refrigeration, Shutoff	Refrigeration/Heating Systems	B	
Valve-Relay Air	Fluid Systems	D	
Valve-Relay Air, Special Design	Fluid Systems	C	
Valve-Relief and Exhaust, Special Design	Fluid Systems	B	
Valve-Relief, Boiler Safety	Refrigeration/Heating Systems	C	
Valve-Restrictor, Pneumatic	Fluid Systems	B	
Valve-Rotary, Directional Control	Fluid Systems	B	
Valve-Rotary, Directional Control, Special Design	Fluid Systems	B	
Valve-Rotary, Hydraulic, Flow Control	Fluid Systems	C	
Valve-Safety Relief	Fluid Systems	B	
Valve-Safety Relief, Angle	Fluid Systems	B	
Valve-Safety Relief, Angle, Level 1	Fluid Systems	B	
Valve-Safety Relief, Globe	Fluid Systems	B	
Valve-Safety Relief, Level 1	Fluid Systems	B	
Valve-Safety Relief, Refrigeration	Refrigeration/Heating System	A	

(continued)

STANDARD COMPONENTS LIST NOMENCLATURE
INDEX (continued)

Nomenclature	HM&E WBS Category	Complexity Category	Page No.
Transmitter-Rudder Angle	Electrical Systems	C	
Transmitter-Shaft Revolutions	Electrical Systems	D	
Transmitter-Ships Course	Electrical Systems	C	
Transmitter-Temperature Electrical Resistance	Electrical Systems	D	
Transmitter-Thrust	Electrical Systems	B	
Transmitter-Wind Direction and Speed	Electrical Systems	E	
Trash Disposal Unit	Deck and Hull Machinery	E	
Trolley Assembly	Deck and Hull Machinery	D	
Trolley-Landing Craft Handling System	Deck and Hull Machinery	D	
Trolley-Monorail	Deck and Hull Machinery	E	
Tug Bar-Electric	Deck and Hull Machinery	C	
Tumbler-Laundry Drying	Deck and Hull Machinery	D	
Unit Heater-Air Circulating, Steam	Refrigeration/Heating System	B	
Valve-Angle	Fluid Systems	B	
Valve-Angle, Level 1	Fluid Systems	B	
Valve-Angle, Refrigeration Shutoff	Refrigeration/Heating System	C	
Valve-Angle, Special Design	Fluid Systems	B	
Valve-Angle, Subsafe	Fluid Systems	B	
Valve-Astern	Fluid Systems	C	
Valve-Automatic Stop and Check, Level 1	Fluid Systems	B	
Valve-Automatic Stop and Check, Special Design	Fluid Systems	C	
Valve-Balancing	Fluid Systems	B	
Valve-Ball	Fluid Systems	C	
Valve-Ball, Level 1	Fluid Systems	B	
Valve-Ball, Special Design	Fluid Systems	D	
Valve-Ball, Subsafe	Fluid Systems	D	
Valve-Bubbler	Fluid Systems	B	
Valve-Butterfly	Fluid Systems	B	
Valve-Butterfly, Special Design	Fluid Systems	C	
Valve-Check	Fluid Systems	C	
Valve-Check Ball	Fluid Systems	B	
Valve-Check Ball, Special Design	Fluid Systems	B	
Valve-Check Inline	Fluid Systems	B	
Valve-Check Inline, Hydraulic	Fluid Systems	B	
Valve-Check Inline, Level 1	Fluid Systems	B	

(continued)

APPENDIX G

LIST OF ACRONYMS

AC	Alternating Current
APL	Allowance Parts List
BRF	Best Replacement Factor
C/E	Components/Equipments
COSAL	Coordinated Shipboard Allowance List
CSSM	Compact Simplified Standardization Model
Enhanced SLCCM	Enhanced Standardization Life-Cycle-Cost Model
FLSIP	Fleet Logistic Support Improvement Plan
HM&E	Hull, Mechanical, and Electrical
LAPL	Lead Allowance Parts List
LCC	Life-Cycle Cost
LCCM	Life-Cycle-Cost Model
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
MIP	Maintenance Index Page
NAVMAT	Naval Material Command
NAVSEA	Naval Sea Systems Command
NAVSEC	Naval Ship Engineering Center
NAVSSES	Naval Ship Systems Engineering Station Detachment - Mechanicsburg, PA
NAVSUP	Naval Supply Systems Command
NAVWESA	Naval Weapons Engineering Support Activity
NMDL	Navy Management Data List
NSN	National Stock Number
OBRP	On-Board Repair Parts
SCL	Standard Components List

SSM	Simplified Standardization Model
SLCC	Standardization Life Cycle Cost
SLCCM	Standardization Life-Cycle-Cost Model
SPCC	Ships Parts Control Center
SWBS	Ship Work Breakdown Structure
TRF	Technical Replacement Factor
WBS	Work Breakdown Structure